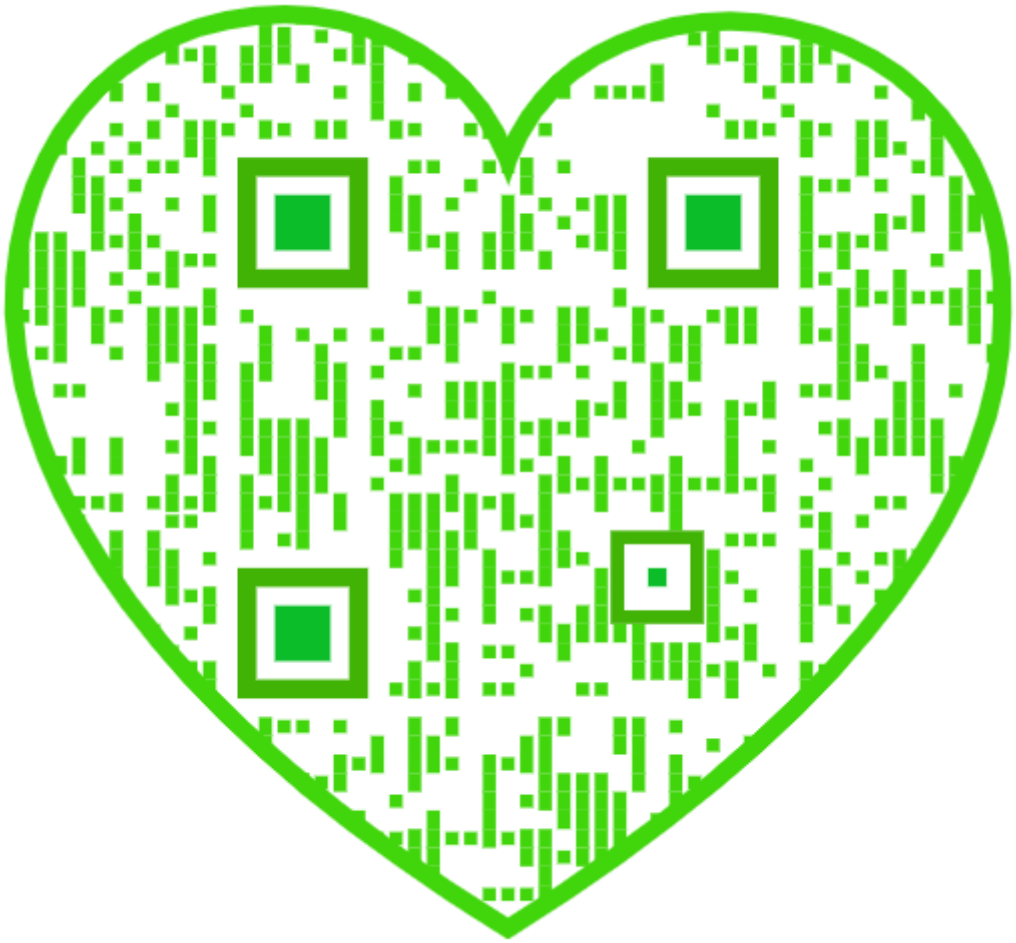
THE HORSE

ITS TREATMENT IN HEALTH & DISEASE



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THE HORSE

ITS TREATMENT IN HEALTH AND DISEASE

SKIN MARKINGS I

Black, White Snip on Nose — Brown, White Face

Skewbald

Bay, White Blaze — Chestnut, White Star

ITS TREATMENT IN HEALTH AND DISEASE

WITH A COMPLETE GUIDE TO BREEDING
TRAINING AND MANAGEMENT

Edited by

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"Lithotomy or the Removal of Stone from the Bladder of the Horse"

DIVISIONAL VOLUME IX

LONDON

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CONTENTS

DIVISIONAL-VOLUME IX

SECTION XI.—WARRANTY (*Continued*)

Page

PATENT DEFECTS (*Continued*) - - - - - - - - - - - 413

DEALERS AND PRIVATE PERSONS AND OTHERS - - - - - - - 414

SOUNDNESS - - - - - - - - - - - - - - 419

VICES - - - - - - - - - - - - - - - 424

SECTION XII.—HORSE-SHOEING

HISTORY OF HORSE-SHOEING - - - - - - - - - - - 429

ANATOMY AND PHYSIOLOGY OF THE FOOT - - - - - - - - 433

Internal Structure of Hoof - - - - - - - - - - 435
Growth of Hoof - - - - - - - - - - - - 436
Cartilage - - - - - - - - - - - - - 436
The Frog - - - - - - - - - - - - - 437

PREPARATION OF FEET FOR SHOEING - - - - - - - - - 438

SHOES - - - - - - - - - - - - - - 441

Material - - - - - - - - - - - - - 441
Weight - - - - - - - - - - - - - 442
Thickness - - - - - - - - - - - - 442
Width - - - - - - - - - - - - - 442
The Foot Surface of Shoes - - - - - - - - - 442
Ground Surface - - - - - - - - - - - 443
"Calkins" - - - - - - - - - - - - 444
Toe-pieces - - - - - - - - - - - - 444
Nails and Nail-holes - - - - - - - - - - - 444
Prepared Bar-iron - - - - - - - - - - - 445
Machine-made Shoes - - - - - - - - - - - 446

FITTING SHOES - - - - - - - - - - - - - 446

Care in Fitting - - - - - - - - - - - - 446

Page

Circumferential Fitting - - - - - - - - - - - 447
Surface Fitting - - - - - - - - - - - - 448
Hot and Cold Fitting - - - - - - - - - - - 449
Clips - - - - - - - - - - - - - 449

Nailing On the Shoe - - - - - - - - - - - - 450

Roughing - - - - - - - - - - - - - 451

Injuries from Shoeing - - - - - - - - - - - 452

Nails - - - - - - - - - - - - - 453
Clips - - - - - - - - - - - - - 453
Uneven Pressure of the Shoe - - - - - - - - - 453
"Cutting" or "Interfering" - - - - - - - - - 455
Over-reach - - - - - - - - - - - - 457
Clacking or Forging - - - - - - - - - - - 457

Section XIII.—THE TRANSIT OF HORSES

Sea Carriage - - - - - - - - - - - - - 461

Diet - - - - - - - - - - - - - 463
Medicines - - - - - - - - - - - - - 463
Horse Boats - - - - - - - - - - - - - 463

Land Carriage - - - - - - - - - - - - - 464

Section XIV.—THE HORSE AND ITS POSITION IN THE ANIMAL WORLD

The Horse of the Present and the Past - - - - - - - 471

Special Features in Structure - - - - - - - - - - 484

Bony Framework - - - - - - - - - - - - 485
Muscular System - - - - - - - - - - - - 490
The Head - - - - - - - - - - - - - 492
Colour - - - - - - - - - - - - - 495
Size - - - - - - - - - - - - - - 496
The Ass - - - - - - - - - - - - - - 496
Zebras - - - - - - - - - - - - - - 496

Skin Markings and Callosities of the Horse - - - - - 497

Skin Markings - - - - - - - - - - - - 497
Callosities (Chestnuts and Ergots) - - - - - - - - - 500

False Nostrils and Guttural Pouches - - - - - - - - 508

Fossil Ancestors of the Horse - - - - - - - - - - 509

Section XV.—THE HISTORY OF THE HORSE

Page

Horses of the Past - - - - - - - - - - - - 517

The Grecian Horse - - - - - - - - - - - - 521

The Horses of Rome - - - - - - - - - - - - 525

The Horses of Asia and Africa - - - - - - - - - - 531

The Arab and the Barb - - - - - - - - - - - 531

The Horse in Britain - - - - - - - - - - - 535

GLOSSARY - - - - - - - - - - - - - - 551

INDEX - - - - - - - - - - - - - - - 563

ILLUSTRATIONS

DIVISIONAL-VOLUME IX

FULL-PAGE PLATES

Page

SKIN MARKINGS—I (*colour*) - - - - *Frontispiece*

HACKNEY MARE, LADY KEYINGHAM (*colour*) - - - - - - - - 444

MR. ARMOUR'S TEAM OF DAPPLED GREYS—DAPPLED GREY GELDING - - 498

SKIN MARKINGS—II (*colour*) - - - - - - - - - - - - 502

MICROSCOPIC STRUCTURE OF PLANTAR PADS, CHESTNUTS, AND ERGET, - - 508

SKELETON OF PHENACODUS SKELETON OF PROTOROHIPPUS - - 510

COMPARISON OF THE FORE AND HIND FEET OF THE HORSE WITH THOSE OF SOME OF ITS ANCESTORS - - - - - - - - - - 512

SKULLS OF SOME ANCESTORS OF THE HORSE - - - - - - - - 544

PRJEVALSKY'S MONGOLIAN WILD HORSE— RESTORATION OF THE FOUR-TOED ANCESTOR OF THE HORSE - - - - - - - - - - - - 520

ASSYRIAN HORSES—GREEK HORSES - - - - - - - - - 524

THE DARLEY ARABIAN —THE GODOLPHIN ARABIAN - - - - - - 534

ECLIPSE—FLYING CHILDERS - - - - - - - - - - - 538

TEXT ILLUSTRATIONS

	Page
Divers Shapes of Shoes	431
Normal Foot: front view	433
The Wall of the Foot: Hoof showing Insensitive Laminæ, &c.	434
The Sensitive Foot: Side View	435
The Sensitive Foot: Sole and Frog	435
Lateral Cartilages, &c., of the Foot	437
Under Surface of the Coffin-Bone, showing its Position within the Hoof	437
Overgrown Foot	439
Well-proportioned and Ill-proportioned Feet	440
A Pared-out Sole	441
A "Seated" Foot Surface	443
A Bad Foot Surface	443
Rodway Iron Shoe with Double Grooves	443
A "Concave" Ground Surface	443
Calkins	444
Nail-holes	444
Wrongly-placed Nail-holes	445
Pitch for Nail-holes for Quarters	445
Pitch for Nail-hole for Toe	445
Shoe Fitted Short at the Heel	447
An "Eased" Heel	448
Shoe with Level Bearing	448
Shoe Imitating a Worn Ground-surface	448
Frost-nails	451
Steel Sharps to be Screwed into Shoes when required	452
Three-quarter Shoe	454
Sand Crack, showing Method of Paring the Crust	455
Shoe for Cutting, showing Position on the Foot	455
Shoes for Cutting	456
Over-reaching, Forging, and Clacking	457
Bartrum's Tethering Apparatus	466
Bones of the Foot of an Odd-toed and an Even-toed Animal	476
Comparative View of Skeletons of Man and Horse	486
Section of Finger of Man	488
Section of Foot of Horse	488
Foot of Man and Foot of Horse Compared in Natural Positions	489
Foot of Man and Foot of Horse Compared (positions reversed)	490
Side View of Skull of Man, with the bone removed so as to show the whole of the teeth	492
Side View of the Skull of the Horse, with the bone removed so as to show the whole of the teeth and nasal bone	493
Section of Unworn Incisor of Adult Horse	495
Glyptodon reticulatus, restored from the remains exhibited in the Natural History Museum, South Kensington	498
Plantar Surface of the Foot of—A, Man; B, Dog; and C, Horse	503
A large chestnut from a cart mare—Ergot from same animal—Bare patch from fore-leg of an ass—Bare patch from fœtus of mare	505
Sections of Chestnut and Ergot of Horse and Bare Patch of Ass	507
Upper Molars of Fossil Ancestors of the Horse	511
Short- and Long-crowned Molar Teeth	511
Radius and Ulna of Fossil Ancestors of the Horse	512

It should be noticed that, as the law now stands, a written warranty can be varied by parole evidence (*Graves v. Key*, 3 B. v. Ad. 313, 1832).

A distinction should also be drawn between patent defects, which are the defects of disease, accident, &c., and such as are in the nature of natural malformations.

These latter are patent, and may seriously interfere with a horse's action, as where it is cow-hocked, but a warranty will not cover them. Whether curby hocks are a natural malformation or not is a moot-point, and in *Brown v. Elkington* (8, 7 v. W. 132, 1841) the jury, under the judge's direction, found for the defendant on the ground that curby hocks are not, like splints, symptoms of disease, but malformation for which the seller is not liable.

One question that naturally suggests itself in connection with this subject of patent defects is, what is the position of dealers in respect of it? These, it is clear from their special training, are better able to judge of, and would be quicker to notice, defects than an ordinary or unskilled person, and defects that would not be patent to the latter might be so to them. The answer is that the law makes no distinction between skilled and unskilled persons in respect of patent defects, but the former are placed in the same favourable position as the latter in this respect. And rightly, as a man's special skill should not be pleaded to his disadvantage. Of course, where defects are so patent as to be obvious to any one, neither a dealer nor a private person would be protected by a warranty. Many defects are obvious to any one, as, for instance, broken knees and severe lameness. Vice, too, can hardly be concealed. Very often, however, a warranty is impugned when the buyer only is in fault. A horse that was perfectly free from vice when sold may be rendered vicious by cruel or improper treatment; or a horse that was perfectly quiet to ride or drive in the hands of its former owner may become restive from want of exercise and from high feeding.

Defects, of course, that are not patent may be covered by a warranty; but so indeterminable is the law of patent defects as applied to horse warranty, that many dealers refuse to give warranties either absolutely or for more than a certain time. We have already shown that a warranty given by Messrs. Tattersall at their weekly sales at Albert Gate extends only to two days, and a common warranty from Horncastle Fair lasts twenty-eight days.

DEALERS AND PRIVATE PERSONS AND OTHERS

We have already had occasion to notice the position of dealers as compared with private persons in treating of patent defects.

In this relation the law makes no distinction between dealers and non-dealers, and hence the former in this respect occupy a decidedly favourable position by reason of their special knowledge.

In other respects, however, dealers are placed at a disadvantage. So, by the statute, 29 Car. 2 C., 7 S.L., it is enacted that no tradesman, artificer, workman, labourer, or other person whatsoever *shall do or exercise any worldly labour, business, or work of their ordinary callings*, upon the Lord's Day, or any part thereof (works of *necessity* and *charity* only excepted); and that every person of the age of fourteen years offending in the premises (that is, in the aforesaid provisions) shall forfeit five shillings. Under this statute it has been held that a horse-dealer cannot sue for a breach of warranty made on the sale of a horse which he purchased on a Sunday (*Fennell v. Ridler*, 5 B. v. C. 406). A sale, however, on a Sunday, which is not made by the seller or his agent in the exercise of his *ordinary calling*, is not void either at common law or under the above statute (*Scarfe v. Morgan*, 4 M. v. W. 270, 1838; *Drury v. De Fontaine*, 1. Raunt. 131, 1808); and in *Bloxsome v. Williams* it was held that a person who had bought a horse of a dealer, warranted sound, on a Sunday, but did not know that the vendor was a dealer and exercising his ordinary calling, could sue upon such warranty. The case of *Smith v. Sparrow* (4 Bing. 84, 1827) is important, because in it the judges doubted the decision in *Bloxsome v. Williams*, and referred with high approval to the case of *Fennell v. Ridler*. Horse-dealers, farmers, and others, therefore, whose *ordinary calling*, or part of whose ordinary calling, it may be to sell horses, should be careful not to sell or give a warranty upon a Sunday. Otherwise they are liable to have the sale repudiated, and the horse returned upon their hands; or they may find themselves the defendants in an action for breach of warranty to which they will have no defence.

Another respect in which dealers differ from private persons is that of agency.

In some cases an agent is undoubtedly able to give a warranty. Whether he is or is not so able depends upon the nature of the agency and upon the position of the principal. Horse-dealers and others could hardly carry on their trade unless they were able to delegate their authority to a representative. Such a representative would be known

as a general agent, and, in the absence of express notice to a purchaser, would have power to do all that is generally done in carrying on such a trade. So the keeper of a livery stable is liable to an action for breach of warranty upon a warranty given by his servant, though he had expressly given such servant instructions not to warrant, for the public is not supposed to know of any private arrangement between principal and agent, where the latter is acting within the general scope of his authority.

This last reservation is important, as where an agent does any act, which does not form a part of his duties or employment as an agent, his principal is not bound. (*Fenn v. Harrison*, 3 T.R. 757, 1790; *Howard v. Sheward*, L.R. C.P. 148, 1866.) So too the servant of a private person, who is entrusted with the sale of a horse at a fair or other public mart, would appear to have power to warrant and bind his principal by such warranty, as it is usual, in the course of business, for the person in possession to have such power. (*Brady v. Todd*, 9 C.B., N.S. 592, 1861; *Alexander v. Gibson*, 2 Camph. 555, 1811; *Brooks v. Hassal*, 49 L.T. 569, 1883.) Except, however, in such a case, the servant of a private person, who has been instructed to sell and deliver a horse on a particular occasion, is not thereby authorized to give a warranty; and if a buyer takes a warranty from such servant, he will have to prove, in order to bind the principal, that the servant was authorized to give such warranty. (*Brady v. Todd*, vide supra.) It should be noticed that in both the cases instanced above, where the principal is bound by the act of the agent, he is so bound by general custom or usage—in the case of the dealer, because the agent is a general agent, who, in conducting his principal's business, has a generally understood power to grant warranties; in the case of the private owner, because it is customary for a person in possession of a horse at a fair or public mart, and entrusted with the sale of such horse, to possess all the powers of the owner, including that of warranty. He would not in this case be a general agent, but rather a special agent with general powers. In no other case, however, would such a presumption be allowed as against a private owner, as it is no part of his business to sell horses, nor can his servant be assumed to have the powers necessary in the case of a horse-dealer for the conduct of his business.

Where an auctioneer is instructed to sell, he may be the agent of both buyer and seller for the purpose of signing the memorandum contemplated by the statute of frauds (29 Car. 2 C. 3).

Whether he is so or not, however, depends somewhat on circumstances. Where the sale takes place at a private place, he is the agent of the seller

only, and wherever the place of sale may be, he only becomes the agent of the buyer on the fall of the hammer (*Warlow v. Harrison*, 28 L.J. 2 B. 18, 1858). There is no need to give a written authority to an auctioneer. The mere act of sending a horse to a repository for the sale of horses would be taken as an implied authority to sell, and an owner would be bound by a *bona-fide* sale even without his express consent. "An auctioneer has a possession coupled with an interest in goods which he is employed to sell, not a bare custody, like a servant or shopman. There is no difference whether the sale be on the premises of the owner or at a public auction-room; for the premises of the owner an actual possession is given to the auctioneer and his servants by the owner, not merely an authority to sell. I have said a possession coupled with an interest; but an auctioneer has also a special property in him with a lien for the charges of the sale, the commission with the auction duty, which he is bound to pay." (Wilson, Justice, in *Williams v. Millington*, I.H., Bl. 81, 1788.)

Where a horse is sold at a repository on the condition that, if it does not answer the warranty given with it, it may be returned within a certain time, the auctioneer is statute-holder between the seller and purchaser, and the money paid by the latter does not rest in the seller until such time has elapsed. The purchase-money, until such time has elapsed, should be retained by the auctioneer. A misdescription of horse put up for sale by the auctioneer will vitiate a sale, and may even amount to fraud, as if a horse be wrongly described as the property of a certain gentleman deceased, or as belonging to a certain stud. Where, too, it is expressed in the conditions of the sale that "the highest bidder shall be the purchaser, and if a dispute arise, it shall be decided by a majority of the persons present", it would be fraudulent for the seller to bid either himself or by an agent.

Puffing also is illegal, and if the buyer finds it out, the seller cannot recover the price (*Pilmore v. Hood*, 5 Bingham, N.C. 97, 1838). This point was fully considered in *Crowder v. Austin* (3 Bingham, 368, 1826). This action was brought to recover the price of a horse sold at Aldridge's Repository, where one of the conditions of sale was that each horse should be sold to the highest bidder. The seller had employed his groom to run up the price of the horse, and the buyer, having discovered this, refused to take it. The plaintiff was non-suited. Auctioneers have also a lien (or claim) upon horses sold by them for their commission and charges (*Robinson v. Rutter*, 4 E. v. B. 954, 1855; *Williams v. Millington*, v. supra; and *Grice v. Kenrick*, L.R. 5, 2 B. 340, 1870). Where fraudulent representations are put into the mouth of the auctioneer, the seller cannot recover the price (*Murray v. Mann*, 2 Exch. 538, 1848).

Generally, it may be stated that a sale in a fair or market overt is binding upon all persons claiming any property in the thing sold. In the country, market overt is only held upon certain fixed days, in a place specially set apart for the purpose; but shops are not market overt. In the city of London every shop is market overt for the class of goods usually sold there, and every day, except Sunday, is a market day. In the case of horses, the general rule as regards sales in market overt are somewhat modified by statute. The first statute dealing with the question was passed in 1555 (2 v. 3 P. v. M.C. 7), and this was followed in 1589 by another (31 Elir. C. 12). They provide *inter alia* that, in all fairs and markets overt where horses are sold, a toll-keeper shall be appointed to keep the place from ten o'clock in the morning till sunset, and to take tolls for all horses. Such toll-keeper was further required to enter the names, descriptions, and addresses of buyers and sellers in a book kept for the purpose, together with a full description of the horses sold. These statutes were mainly directed against horse-stealing, and practically effected their object.

It should be noticed here that a sale at a repository outside the city of London is not a sale in market overt (*See v. Bayes*, 18 C.B. 599, 1856).

Another class of persons who are liable to the laws of warranty are job-masters. When a job-master lets out a horse or carriage for any particular purpose, he is taken to have warranted it for that purpose.

This reservation is important, as such liability ceases if the hirer has used the horse for any other purpose than that for which it is let out.

Thus, if a horse is let out for riding, the hirer must not put it into harness; if he does so, and an accident thereby happens, he, and not the owner, is liable.

Generally, also, if the hirer keeps the horse for a longer period than that for which it is hired, he is responsible. With these exceptions, however, and certain others which I shall presently notice, the letter is responsible for every accident and loss which he cannot prove to have been due to the positive negligence of the hirer (*Cooper v. Burton*, 3 Camp. 5, 1810). What constitutes negligence in contemplation of law is not capable perhaps of exact definition.

Some acts, however, are clearly negligent.

Thus, in driving on the wrong side of the road, one is bound to exercise more than ordinary care to avoid a collision; if one do not exercise such care, and an accident happens, one will clearly be liable for such accident on the ground of negligence. So, too, a hirer has been held liable for "overdriving" a horse (*Walley v. Holt*, 35 L.T., N.S., 630, 1876).

But where a horse is returned with broken knees the letter must prove negligence in the hirer (*Cooper v. Burton*, v. supra).

If a horse fall ill during the hiring, and the hirer prescribes for it himself and the horse dies, he is liable, but not if he calls in a farrier (*Deane v. Keate*, 3 Camp. 4, 1811); also, if a horse become exhausted and refuse its food, the hirer must discontinue the use of it (*Bray v. Maine*, Gow. 1, and see *Edwards v. Carr*, 13 Gray's Massachusetts Rep. 234, 1859). To support an action for negligence the rule is that there must be some affirmative proof of negligence; where the evidence does not go to prove which party failed to take proper care, the plaintiff will fail in his action. Further, if there has been contributory negligence, that is if an accident alleged to have been caused by the negligence of the defendant would not have happened but for negligence on the part of the plaintiff, the latter could not recover. The owner is also bound to supply strong and proper harness where a horse is employed to draw any vehicle, and is liable if any accident occurs through the reins breaking (*Cotterill v. Starkey*, S.C. v. P. 693). It was there stated that "if a person driving along the road cannot pull up because his reins break, that will be no ground of defence, as he is bound to have proper tackle". It was also decided in this case that "a foot-passenger has a right to cross a highway, and persons driving carriages along the road are liable if they do not take care, so as to avoid driving against the foot-passengers who are crossing the road". They are also bound "to drive slowly, cautiously, and carefully over a crossing for foot-passengers", while a correlative duty is cast upon the foot-passengers "to use due care and caution in going upon a crossing, so as not recklessly to get among the carriages (*Williams v. Richards*, 3 C. v. K. 82). "The rule", however, "as to the proper side of the road does not apply with respect to foot-passengers; and as regards foot-passengers, the carriages may go on whichever side they please" (*Cotterill v. Tuff*).

Where a job-master lets horses by the day, week, or job, and also supplies the driver, he is generally responsible for all the injuries resulting from careless driving; if, however, the hirer supplies the driver, he would appear to be responsible for any accident or loss arising from negligence or want of skill in such driver (*Croft v. Alison*, 4 B. v. Ald. 590) Where, however, the letter supplies the driver, the hirer may make himself responsible under certain circumstances, as where he takes upon himself the actual management of the horses, or directs the driver to do something unusual or improper, in consequence of which an accident happens (*Quarman v. Burnett*, 6 M. v. W., 507).

The mere fact of the hirer sitting on the box-seat alongside the driver will not, however, as commonly supposed, relieve the latter of responsi-

bility. Of course, if an accident happens through a servant exceeding or not acting within the scope of his duties, the master is not liable. What acts are and what are not within the scope of the servant's employment it is not always easy to determine, and is a question that must necessarily depend to a large extent upon the facts of each particular case.

SOUNDNESS

What is meant by soundness has been variously stated in works upon the horse and also in decided cases. According to Baron Parke in *Kiddell v. Burnard*, "the word 'sound' means what it expresses, namely, that the animal is sound and free from disease at the time it is warranted to be sound"; and in the same case Baron Alderson says, "the word 'sound' means sound, and the only qualification of which it is susceptible arises from the purpose for which the warranty is given. If, for instance, a horse is purchased to be used in a given way, the word 'sound' means that the animal is useful for that purpose, and 'unsound' means that he at the time of sale is affected with something which will have the effect of impeding that use." Such may be taken to embody the legal definition of soundness.

Positive definitions are, however, rarely satisfactory, and for practical purposes a negative definition, that is a definition of unsoundness, is at once easier and better. "Stonehenge" gives the definition of unsoundness as "the existence of disease or alteration of structure which does or will impair the horse's natural usefulness". Unsoundness, therefore, would appear to be caused by disease or alteration of structure either actually or prospectively impairing a horse's usefulness. The diseases that constitute unsoundness we shall presently consider; what is meant by "alteration of structure" may be disposed of at once. A sound horse has been defined as "a horse in perfect health, with perfect action or motion of all its limbs and organs". Not that, to be sound, a horse must exactly fulfil these requirements—very few horses do—but a horse may be said to be perfect in health and limb without being ideally perfect. A horse, for instance, with some natural malformation may be perfectly sound, as already intimated, since natural malformation does not constitute unsoundness, and yet not be perfect in such a sense. A horse, however, that had been "nerved" would not be sound. In *Best v. Osborne* (R. v. M. 290), where a horse moved soundly enough, but had been "nerved" to cure it of lameness, Mr. Justice Best remarks: "Sound means perfect, and a horse deprived of a useful nerve is imperfect, and has not that capacity for service which is stipulated for in a warranty of soundness".

It remains further to consider what diseases or defects do, and what do not, constitute unsoundness. It will clear the ground if we deal with the latter class first.

Bog spavins are caused by sprain or hard work, and in the slighter cases do not constitute unsoundness. If, however, they cause lameness, the case is otherwise, though lameness alone amounts to unsoundness. Spavins generally we shall have occasion to consider later.

Broken knees, when the joint is not so injured as to impair its action, do not amount to unsoundness.

Capped hocks and elbows do not render a horse unsound, so long as they do not cause lameness or interfere in any way with the action of the joints.

Contraction of the foot is not in itself a mark of unsoundness. It is, however, frequently a result of unsoundness, as of navicular disease, and will then amount to unsoundness.

We may here also conveniently notice rings on the hoof. These are sometimes regarded as marks of unsoundness, though they are not necessarily so.

When a horse suffers from a disorder the growth of the hoof becomes less active, resulting in the formation of a groove, and then, when the horse is turned out to grass, healthy growth is renewed, thus causing a ring. Blisters, too, if used periodically, will cause a rapid growth of the hoof for the time, and a series of rings will result as a consequence.

Curby hocks are not unsoundness. In the celebrated case of *Brown v. Elkington* (8 M. v. W. 132), Lord Abinger remarked that "a defect in the formation of the horse, which had not occasioned lameness at the time of sale, though it might render the animal more liable to be lame at some future time, was no breach of warranty". This view was upheld by the Court of Exchequer, which refused to grant a new trial.

Cutting is not unsoundness, unless the horse is lame from it at the time of sale. It is, in fact, often the result of bad shoeing.

Soreness of the joints arises from overwork and is not accounted unsoundness.

Splints do not amount in every case to unsoundness, but only when they cause, or by their size, form, or position are likely to cause, lameness. The leading case on splints is *Margetson v. Wright*, to which we have already had occasion to refer.

Thoroughpin in a moderate degree would not appear to amount to unsoundness. As this, however, is a matter of opinion, it is unwise to warrant a horse sound if suffering from this disease.

Thrush, when only a consequence of mismanagement, and not caused

by any disease or defect in the horse, will not be held to amount to unsoundness.

Windgalls usually arise from overwork, and when of small size and unproductive of lameness, do not constitute unsoundness.

We now come to consider those diseases or forms, or stages of disease, which do constitute unsoundness.

Blindness.—All forms or degrees of blindness which impair a horse's usefulness amount to unsoundness.

Bog spavins, when so severe as to interfere with the action of the joint, amount to unsoundness.

Breaking down.—A horse is said to be broken down when through an extraordinary strain on the sinews and tendons of the leg it has become temporarily lame, and the part affected is swollen and inflamed. The swelling may sometimes be so reduced as to pass unnoticed by an ordinary buyer, but a broken-down horse is undoubtedly unsound.

Broken Knees.—These, when the injury is only slight and superficial, do not, as already intimated, render a horse unsound; but when the knees have been so badly broken as to allow the synovia, or joint-oil as it is called, to escape, or when the skin over the knees has become so thickened, in consequence, as to impede their action, the horse will be unsound. The latter kind of unsoundness, however, occurs more especially when a horse has been thrown down repeatedly, or when the injury has been deep and severe.

Cataract constitutes unsoundness in every stage of the disease.

Cold.—This is unsoundness, and will vitiate a warranty of soundness if the horse is suffering from a cold at the time of sale.

Corns, which generally occur in the fore-feet, are usually held to be a mark of unsoundness, and if they cause, or are likely to cause, lameness, are so. If, however, they are superficial and only of a trifling nature, they would not apparently amount to unsoundness. In an aggravated form, or in any of their more serious developments, they would unquestionably amount to unsoundness.

Coughs.—A cough will render a horse unsound, that is, of course, if the horse had it at the time of sale. To avoid unnecessary litigation, however, it should be observed that horses are specially liable to acquire this ailment, and if they do so at any period after sale, there can be no return for breach of warranty.

Curbs are accounted unsoundness, even though there be no lameness. A horse with a curb, sold under a general warranty, can be at once returned; if, however, the curb be pointed out at the time of sale, it will be a case of special warranty, and the buyer must be upon his guard. Curby hocks have already been noticed.

Farcy, a disease identical with glanders, renders a horse unsound.

Fever in the Feet, Founder, or Laminitis alters the structure of the foot, and therefore amounts to unsoundness. This disease alone, apart from other considerations, renders a horse unsound, because the laminæ are so affected by the disease that a horse which can be proved to have suffered from it is most likely to fall lame if put to work. Dropping and bulging of the sole of the foot and displacement of the bones is often a result of laminitis.

Glanders is a most serious disease, sometimes confounded with strangles. A horse sold with glanders should be at once returned and the purchase-money demanded back.[1] If the seller can be proved to have known of the existence of the disease, the buyer may also recover damages. A horse with glanders must not be resold, but destroyed.

Grease, a skin disease generally affecting the heel of the foot, and which will be found dealt with elsewhere, constitutes a horse unsound.

Mange, a parasitic skin disease which is generally apparent, amounts to unsoundness.

Megrims, or fits, renders a horse unsound.

Navicular disease, a disease of the foot, known in its advanced stage as "grogginess", renders a horse unsound.

A "nerved" horse is unsound on two grounds; by reason of the disease for which it was "nerved", and as being structurally imperfect through the nerves having been severed. A "nerved" horse may be able to work, but is at any time liable to become useless on account of the defect.

Ophthalmia is unsoundness. If it has previously existed and again manifests itself soon after purchase, it is most likely of constitutional origin. Evidence of its presence by a competent veterinary surgeon will be sufficient to enable the buyer to rescind the contract.

Ossification of any of the structures adjacent to the joints, and therefore ossification of the lateral cartilages, constitutes unsoundness.

Pumiced foot is unsoundness, as being evidence of laminitis.

Quidding, being an indication of disease or defect in the mouth, is unsoundness.

Quittor, a chronic abscess of the foot, is unsoundness. It is generally accompanied by more or less lameness, which, as already stated, would alone constitute unsoundness.

Ring-bones and **Side-bones,** both large and small, render a horse unsound.

[1] Notice to the vendor must be given, recent law preventing the leading of a glandered horse through a thoroughfare except under special conditions.

Roaring and **whistling,** as evidence of contraction of the entrance to the air-passages, render a horse unsound; in other words, they are evidence of a structural defect, and a roarer or whistler is therefore unsound. This was decided in *Onslow v. Eames* (2 Starkie, N.P.C. 81).

Ruptures of all kinds render a horse unsound.

Sand-cracks, or cracks in the hoof of a horse, sometimes extending from the sole to the coronet, constitute unsoundness. They have been already noticed in treating of "patent defects", and would apparently only invalidate a warranty where the buyer has no power of inspection.

Seedy-toe, which appears as a hole or cavity in the hoof, is a form of unsoundness. **False-quarter,** or sand-cracks in an aggravated form, would clearly amount to unsoundness. The remark as to warranty in cases of sand-crack would apply both to "seedy-toe" and "false-quarter".

Spavin (bone).—A spavined horse has been held to be unsound, although not lame (*Watson v. Denton*, 7 C. v. G. 86). Many good racers and hunters, however, have spavins, which in no way impede their action or inconvenience them.

If a spavin caused lameness, it would undoubtedly render a horse unsound. "Bog" and "blood spavins" have already been noticed.

Strangles, an infectious fever affecting the throat, which is very likely to lay the seeds of roaring and whistling, amounts to unsoundness.

Stringhalt, a peculiar jerky action of the hind-legs, will render a horse unsound. It should be observed that horses with this disease, though unsound, are not incapacitated for any kind of work.

Thickening of the back sinews, or suspensory ligament, will, when appreciable, constitute a horse unsound.

The diseases above noticed, it will be observed, apply for the most part to the feet and legs. They constitute, in fact, in the vast majority of cases, the grounds on which horses are returned for alleged breach of warranty. There are, however, other diseases not so easily discoverable which amount to unsoundness. Generally, it may be stated that all diseases of the internal organs constitute unsoundness, though they are frequently so subtle as to defy detection. Of these it will be sufficient to notice a few to which the horse is more especially liable. Colic and gripes are self-evident, as the horse that suffers from them is convulsed with agony; but chronic *nephritis*, or inflammation of the kidneys, is less apparent, but more insidious. We may also notice *cystitis*, or inflammation of the bladder, *spasm of the neck of the bladder*, *stone in the bladder*, and *diabetes*, all or any of which diseases will render a horse unsound for the purposes of warranty, as will any acute or chronic ailment of the other important organs of the body

VICES

Besides diseases and defects which amount to unsoundness, there are certain faults which will entitle a buyer to return a horse when warranted "free from vice". Of course, it must be clear that such faults existed at the time of sale, and are not the result of subsequent mismanagement or unskilfulness. The first we shall have occasion to notice is:—

Biting.—A biter is manifestly vicious, as being *dangerous* to those who have occasion to approach it. From the great power in a horse's jaw it is capable of inflicting terrible injuries.

Bolting, or running away, is also held to be a vice, if habitual. It is open to question, however, whether a horse that has run away once would not be likely to do so again if a favourable opportunity offered.

Crib-biting, as tending to injure a horse, is sometimes held to be a vice. If it has that effect, it undoubtedly is a vice. Many devices have been tried to cure this habit, with more or less success. One, adopted by a well-known sportsman, is a slung bar in front of the manger, which slips away from the horse as often as he attempts to gnaw it.

Kicking.—This is a very bad and *dangerous* habit, and a confirmed kicker is unquestionably a vicious animal. It is, however, not at all an unusual thing for a high-mettled or even a docile horse to develop a habit of kicking, in consequence of mismanagement or cruelty, which before purchase was perfectly free from the vice. Thus a young horse warranted "quiet to ride and drive", after being kept in the stable a long time and too highly fed, may, on being put into harness, run away, though it had never shown a tendency to do so before; or kick the dashboard to pieces and upset the vehicle, from being urged uphill with sticks. Before returning a horse, therefore, for the alleged vice of kicking, it is always desirable to ascertain, first, whether the horse is a confirmed kicker; and secondly, if it be so, how it acquired such a habit. Kicking when "merely a mode of letting off superfluous spirit" is, of course, not a vice.

Rearing, if it has become a habit, is most dangerous, as the horse may fall backwards upon and kill its rider. In this stage it is probably incurable, and is a vice. In a raw, unbroken colt, however, it could hardly be accounted a vice.

Restiveness, in the sense of refusing to go in the direction desired, is a returnable vice.

Shying, when a confirmed habit, is a vice.

Weaving in the stable, or an uneasy moving of the head from side to side, like a wild beast in his cage, is a vice.

We may conveniently sum up this brief enumeration of ailments amounting to unsoundness and returnable vices with the definition laid down in *Elton v. Brogden* (4 Camp. 281): "If at the time of sale the horse has any disease which either actually does diminish the natural usefulness of the animal, so as to make him less capable of work of any description, or which in its ordinary progress will diminish the natural usefulness of the animal, *this is unsoundness*; or if the horse has, either from disease or accident, undergone any alteration of structure that either actually does at the time, or in its ordinary effects will diminish the natural usefulness of a horse, such a horse is *unsound*".

It should also be borne in mind that ailments to amount to unsoundness need not be permanent or incurable. It is sufficient if the horse is affected by such ailment at the time of sale; or even, according to the decision in the leading case of *Margetson v. Wright*, to which we have already had occasion to refer, if the horse has the seeds of unsoundness in him at the time of sale. Even if a horse which was unsound at the time of sale, recovers before action is brought, this is no defence to such action.

We may conveniently close this chapter with a few remarks as to the proper course to be adopted where a horse is believed not to answer to its warranty.

If there can be no mistake about its unsoundness, and that such unsoundness existed at the time of sale, it should be at once returned, with a letter demanding back the purchase-money. It is, however, always desirable to obtain independent veterinary testimony, written if possible, or the opinion of an expert, previous to returning the horse. Such return should also be accompanied by a copy of the veterinary surgeon's report, or the expert's opinion. If the seller refuses to take the horse back, it may be sold, and he may be sued for any deficiency between the price realized at such sale and the price originally paid for it, together with any expenses to which the buyer may have been thereby put. Of course, there must be no unnecessary delay in returning the animal, as the law does not aid those who sleep upon their rights.

No definite time is fixed by law for the return, and each case must be governed more or less by its own peculiar incidents; but generally, in the absence of any stated time, as where the horse has not been sold subject to the rules obtaining at some fair or repository for the sale of horses, eight days inclusive may be taken to be a reasonable limit.

If the horse is very valuable, legal aid should be sought, and action will then be taken in one of the superior courts, but many cases of warranty will naturally come within the jurisdiction of the county courts,

and in that case the plaintiff may desire to conduct his own case. In this latter event he can obtain all necessary information respecting the usual formalities from the officials of the court belonging to the district in which he lives. A few suggestions, however, will not be out of place. All original letters or documents should be carefully preserved, together with the warranty, if written. He should also write out a detailed statement of his claim, of which he should make three copies, one for his own use, one for service on the defendant, and the third to be attached to the plaint note. He should also serve a notice upon the defendant to produce all letters and documents bearing upon the case. The plaintiff should then consider what witnesses he requires to prove his case, and if he has reason to think that any of them will not come willingly, he should subpœna them. His statement in court should be a plain and unvarnished setting-out of the facts, chronologically arranged, up to the discovery and proof of breach of warranty. The defence set up may be a direct denial of the allegations of the plaintiff, or that such alleged breach is the plaintiff's own fault.

If the warranty is in writing, the case will, of course, be much simplified, as the court will be in possession of the exact terms. If the warranty is not in writing, the plaintiff should be careful to give the exact terms of the warranty, since, as already stated, there are many representations which do not amount to, or constitute part of, a warranty.

A written certificate of soundness or unsoundness, it is to be observed, is only of use in court for the purpose of correcting evidence, and the person giving such certificate should be in court, so that the party to whom such certificate is adverse may have an opportunity of cross-examining him. A written warranty, as already stated, need not be stamped. Whether, however, a horse is to be sold with a warranty or not, the intending purchaser should be careful to overhaul him before a bargain is struck, as, where there is full power of inspection, the maxim *caveat emptor*, "at purchaser's risk", will apply, where there is a warranty in respect of patent defects, and where there is no warranty, unconditionally.

HORSE-SHOEING

SECTION XII.—HORSE-SHOEING

HISTORY OF HORSE-SHOEING

The adoption of horse-shoeing marks an advanced stage of civilization in a country. Good roads are essential to social and commercial development, and good roads necessitate horse-shoeing. Until artificial roads are made and generally adopted, the horse's hoof is able to withstand the wear of tolerably long journeys. Between the time of no shoes and the era of shoes fixed by nails a long period of slow evolution intervened. In the days of Xenophon horses were not shod either for civil or military purposes. The armies of Alexander suffered from the effects of wear upon the feet of their horses, and we are told that cavalry was left behind, owing to the damaged state of the horses' hoofs. A form of sandal woven of grass is the earliest protection for the horse's foot recorded, and it was not constantly used, but only employed on horses that were too lame to travel without some temporary cover for the worn or broken hoof. Probably the next stage in hoof-protection would be the use of leather, as less cumbersome than the sandals made from vegetable fibre. Then we pass to the use of metal plates to strengthen the sandals, and next to metal plates attached by leather thongs.

Metal shoes for continuous wear, fixed by nails, came gradually into use in Europe between the fifth and ninth centuries. As skilled workmen would be required to make and fix them, it may be concluded that at first only horses employed for military or court purposes would be generally shod. Then the horses used for traffic in towns would be shod, and as hard roads extended, so would the art of shoeing spread along them for the protection of the feet of horses used for carrying goods or passengers.

There is no account of the art in this country prior to the Conquest, when William of Normandy gave to Simon St. Liz, one of his followers, the town of Northampton and the hundred of Falkley, then valued at £40 per annum, to provide shoes for his horses. In *Brook's Catalogue of Errors*, page 65, it is stated that "he appointed Henry de Ferrers

to be superintendent of the shoeing smiths; and his descendants the Earls of Ferrers bore six horse-shoes on the quarterings of their arms. At Oakham, in Rutlandshire, the seat of the family, a singular custom long prevailed. If any baron of the realm passed through the place, he was to forfeit one of his horse's shoes unless he chose to redeem it by a fine. The forfeited shoe, or one made in its place, was fixed upon the castle gates, inscribed with his name. In consequence of this custom the gates became in time covered with numerous shoes, some of them of unusual size, and others gilt, &c."

From its introduction by the Conqueror, to the time of Elizabeth, we have little recorded account of the shoeing art, but that it was not neglected we may be certain, as one of the old City of London Guilds —the Worshipful Company of Farriers—was founded as early as 1360.

The first work in the English language which contains any detailed account of shoeing is that of Blundeville, published in 1609. In this work, illustrations are given of shoes for general and special purposes, and for sound and unsound feet. These shoes (fig. 623) are very similar in outline to those now used, but are heavy and clumsy, and wanting in some of the little details which are necessary to make them most useful and comfortable. The horse-shoe of Queen Elizabeth's time was merely a bar of iron about twice as wide as it was thick, turned to the outline of the hoof, and supplied with nail-holes punched through its substance. In 1674 the Worshipful Company of Farriers obtained from Charles II a Charter of Incorporation which gave them controlling powers over all farriers within the city of London and for seven miles around. One of the reasons for granting the charter was that "horses were seriously injured by the operations of persons unskilled in the art". In this reign farriers not only shod but doctored the horse, and were the recognized attendants on sick and injured animals.

In the eighteenth century further progress had been made, and more than one useful treatise was published. Two of the most practical writers were Osmer and Clark, who had noticed the injury done to flat feet by the uneven bearings of a flat shoe. They consequently bevelled off a portion of the foot surface of the shoe, so that only its outer portion came in contact with the hoof. Just before the close of the century a French veterinarian arrived in England and founded the Royal Veterinary College. Charles Vial de Sainbel only lived a short while after establishing the college, but during that time he reintroduced a shoe flat on the foot surface and concave towards the ground. The successor of Sainbel at the Veterinary College was a surgeon named Coleman, who took great interest in the horse's foot and shoeing. He published two

volumes—one on the anatomy of the foot, with coloured plates, and one on the principles of shoeing. About the same time a sporting gentleman, Strickland Freeman, issued a book on horse-shoeing. It is difficult to say whether his or Coleman's illustrations were the more artistic and correct. Both were excellent, but it must be confessed that the principles

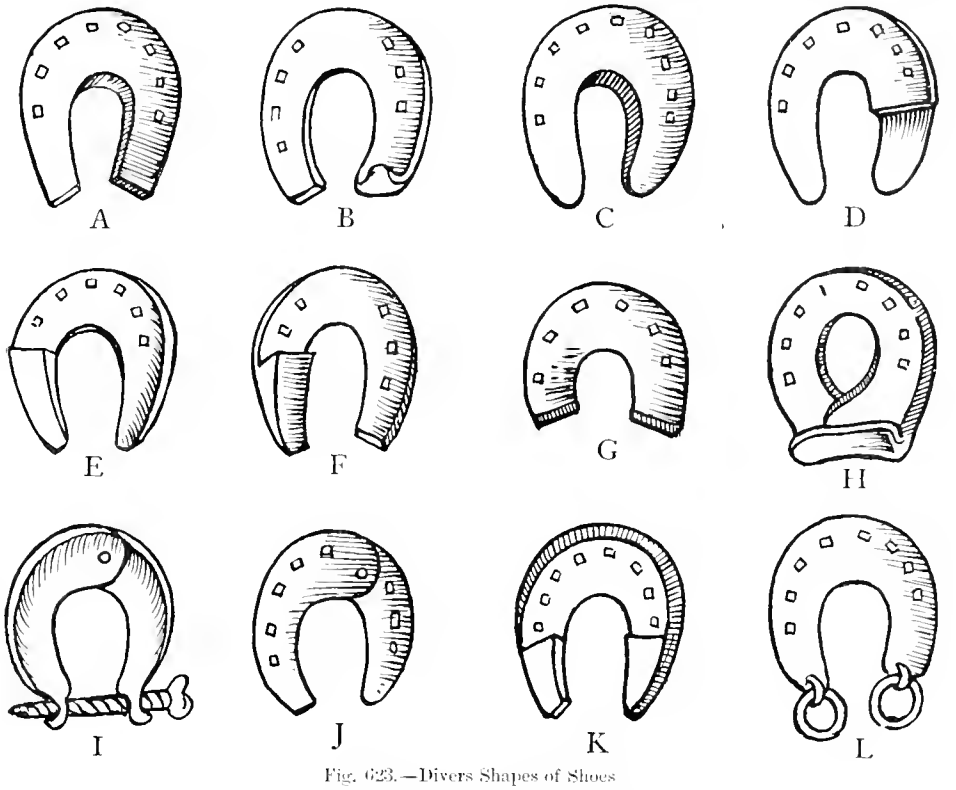


Fig. 623.—Divers Shapes of Shoes

A, A shoe for a perfect horse. B, Hinder shoe for same. C, For a flat-foot or pomised horse. D, For a false quarter, shoe with the inside turned outward to show the shoulderings. E, Fore-shoe for interfering. F, Hind-shoe for interfering. G, Lunet for weak heels. H, The planch for weak heels. I, A shoe with a vice. J, A joint shoe to widen and straighten at pleasure. K, A shoe with a welt or border. L, A shoe with rings to make a horse lift his feet.

of farriery laid down by Freeman were better than those of his scientific rival.

Between 1800 and 1830 the subject of horse-shoeing found many exponents. Bracy Clark, Goodwin, Moorcroft, and Cherry kept up a continuous discussion, which doubtless did much to improve the art, but which introduced some very unfortunate theories, followed by evil practices. Flat shoes and "seated" shoes were offered as panaceas for all kinds of feet. Narrow shoes were pitted against wide shoes, short against long. Frog pressure and short shoes were tried and discarded. Soles were pared thin, and frogs trimmed to favour elasticity. Shoes

were made with hinges to allow expansion, and heated quarrels took place as to the position and direction which nails and nail-holes should take. Each authority pledged himself to some special form of shoe or method of applying it as the only one suitable for all feet. Few, if any, seemed to grasp the fact that horses' feet differed widely in form and substance, and that the best general principles depended largely for success upon the careful performance of every detail.

From 1830 to 1860 not much was written about horse-shoeing. Farriers followed their own line, and rather looked askance at theories and principles. The actual manual work was remarkably well done in the large towns, but too much attention was given to the production of the shoe, whilst the preparation of the foot was neglected save for the neat and smart appearance shown by the whole operation. The hoof was pared and rasped as though it were an inanimate block, with the result that it was more fitted for a table ornament than a basis of support for a horse travelling over rough roads. To the late Mr. Joseph Gamgee belongs the chief credit of the more sensible methods adopted to-day. From 1860 to 1870 he never ceased to write and teach that a horse-shoe was wanted to protect a hoof from wear, that the hoof should be left as strong as possible compatible with its proper proportions, and that the fitting of a shoe to the foot should be exact, whilst every foot should be treated according to its own special requirements. He was ably seconded in his endeavours by Dr. G. Fleming and other veterinarians, with the result that correct principles are now quite understood and fairly widely adopted. During the last decade a new departure has been made in some counties. The technical education committees have recognized the importance of horse-shoeing as a craft, and an endeavour is being made to improve the art by lectures and by practical demonstrations with a travelling forge and an efficient instructor. Now that apprenticeship has fallen into desuetude, this practical instruction is the only way in which many districts can offer facilities for young workmen to see the best work and to have it explained to them.

Few owners of horses appreciate the importance of the best shoeing, which can only be done with time and care. Low-priced work means low-priced labour, and the hurry necessary to obtain a living by it quite prevents men from giving the attention to details which is essential to good shoeing, even when knowledge of principles and manual skill exist. The aim of this article is to afford owners of horses such information as will enable them to know good from bad shoeing, or at any rate to impress them with the fact that the art is an important and difficult one, worth much more attention than it obtains.

ANATOMY AND PHYSIOLOGY OF THE FOOT

Some knowledge of the structure of the foot and of its functions is necessary to an understanding of the principles of horse-shoeing. The hoof is only a layer of horn covering very sensitive parts and affording a base of support for the limb. A damaged hoof cannot properly protect the parts within, and a deformed hoof places the whole limb at a disadvantage even as a column of support—much more so as a propelling organ, when great effort is required for draught, or quick movements for pace.

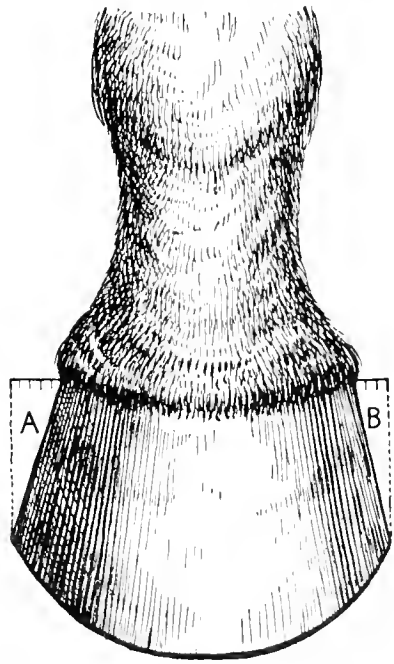


Fig. 624.—Normal Foot: front view, showing slopes of (A) outer wall and (B) inner wall

The hoof is not a regular geometrical figure, it is an irregular one (fig. 624), and this irregular form must be followed in shoeing. If the two front feet be looked at on the ground it will be seen that they are similar in form and size, that the inner surface is more upright than the outer, and that the hoof is much higher in front than behind.

The Wall (fig. 625) is the part of the horn forming the front and sides of the hoof. It grows downwards from the coronet, and as it slopes forward and is constantly growing, there is a continuous lengthening of the toe. The effect of excessive growth is therefore to bring the bearing surface of the foot out of proper relation to the leg, and all overgrown feet afford a disadvantageous position for the horse standing or moving. When a horse is shod his hoof continues growing, and if the shoe be retained too long, the hoof gets disproportionate, and may cause either stumbling or injury to the tendons. The angle at which the front of the wall slopes is a useful guide to the proportions of the hoof. It should be about 45 degrees. When the toe is too long the wall slopes too much, when the heels are too high the front of the wall is too upright (fig. 631). The wall is thicker at the toe than at the heels, and as this variation is gradual from front to back, so nails may be driven into it with less danger towards the toe. The wall does not vary in thickness vertically, so a good workman may safely drive a nail to any reasonable height in its substance. The

outer layer of the wall is the hardest, and thus most capable of resisting wear. It protects the deeper layers, and by preventing evaporation keeps them tough and pliant. The evil of rasping is that the exposed horn soon becomes hard, and a repetition or excess of the process renders the hoof brittle.

When the under surface of the foot is examined, the sole, frog, and bars are seen.

The sole forms the larger portion of the floor of the hoof. It is concave, and firmly attached to the border of the wall. On a smooth, level surface only the outer portion of the sole—that which is immediately connected with the wall—takes a direct bearing. But the sole sustains its share of the weight of the horse just as an arch supports weight although resting only on its abutment.

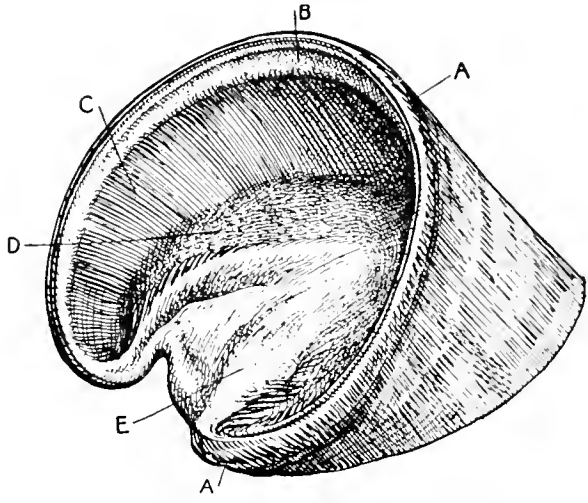


Fig. 625.—The Wall of the Foot: Hoof showing Insensitive Laminæ, &c.

A, Peripolic horn-band. B, Coronary groove. C, Insensitive laminæ. D, Horny sole. E, Horny frog.

The frog is the prominent triangular-shaped mass of horn situated at the back part of the under surface of the hoof. It extends forward to a point reaching more than half-way to the toe. Its prominent surface is broken by a depression which should be shallow, but which is too often a narrow, deep fissure. On each side of the frog is a space separating it from the bars. This space permits lateral yielding when weight is placed upon the frog. It must not be supposed that the frog is an extra thick mass of horn resting on a level sensitive foot. Its prominent parts and its depressions follow exactly a similar formation of the sensitive structure under it, and the whole should be left in its full strength. The form of this division of the hoof suggests its use, which is to form a catch when the foot comes to the ground, and so increase the security of foothold. The structure of the frog is a tough elastic horn, and as the back of the foot comes to the ground first during progression, the frog is well constituted to break concussion.

The bars are the ridges of horn which run on each side of the frog forwards from the heels. They are formed by a turning-in of the wall at

its posterior extremity. Between the bars and the wall are enclosed the extremities of the sole, which are often injured by a badly-fitted shoe, especially upon the inner side, and the resulting bruise is called a "corn". The bars assist in preserving the width of the foot at the heels, and when cut away by the farrier, permit contraction of the hoof.

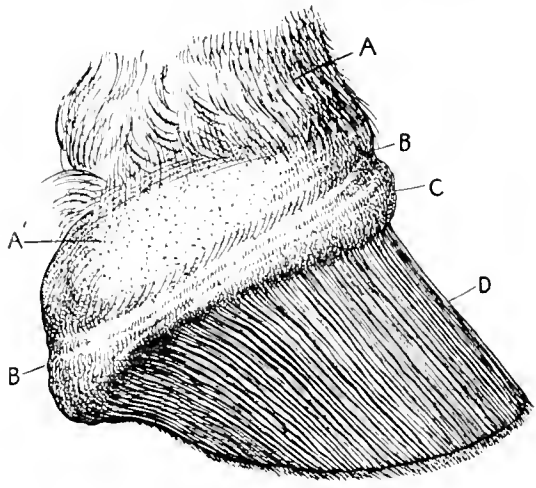


Fig. 626.—The Sensitive Foot: Side View

A, Skin. A', Skin devoid of hairs. B, Peripolic band. C, Coronary cushion. D, Sensitive laminæ.

Bars, sole, frog, and wall form one continuous horny covering to the foot. By long maceration in water they can be separated, but in a healthy living foot they are all firmly united so as to form a sound hoof. Each division should be kept in its most perfect condition, because any long-continued defect of one is certain to affect the other injuriously. If the wall at the heels be left too high, the frog soon shrinks and wastes. If the sole be cut away and weakened, the wall has to support unaided an excess of weight, and it becomes broken and diseased. Wall, sole, and frog must be kept proportionate if the proper relations of the whole hoof are to be maintained.

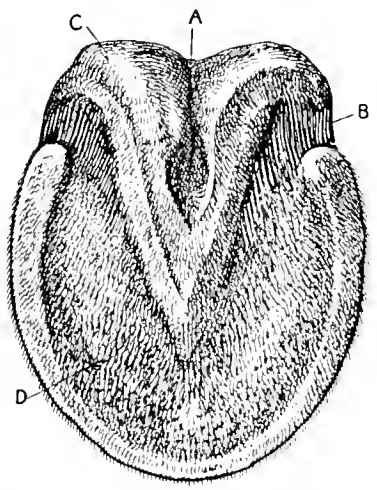


Fig. 627.—The Sensitive Foot: Sole and Frog

A, Median cleft of fleshy frog. B, Laminæ of the bars. C, Velvety tissue of the frog. D, Velvety tissue of the sole.

Internal Structure of Hoof.—Although the hoof is a firm, strong, protecting covering to the sensitive foot within it, very serious injury to the horse results from defects in its structure which are often overlooked. These will be appreciated more readily when it is known that within the hoof is a particularly delicate and complex arrangement. When a hoof is removed with care, a beautiful, sensitive structure is exposed, having a contour exactly matching the inner surface of the hoof (figs. 626, 627). The inner surface of the wall is covered with rows of thin, horny plates running from above downwards parallel to each other, all sloping forwards

like the fibres of the wall. The corresponding portion of the sensitive foot presents hundreds of similar parallel projecting leaves of soft, velvety, fibrous tissue. These are called the sensitive laminæ, and in the living foot are dovetailed between the horny laminæ of the wall so as to afford a firm, secure attachment between the two. The sensitive frog and sole are firmly attached to the corresponding horny parts, but instead of plates the connecting medium here is a mass of little papillæ, so closely arranged as to give a velvety appearance and feel to the exposed surface. This sensitive layer, known to farriers as "the quick", is bountifully supplied with nerves and blood-vessels. Just where the hair meets the horn—the part called by horsemen the coronet—is a very important structure, seen when the hoof is detached. This is a prominent ring or band extending round the foot and covered with very large papillæ. From it the wall grows, and injuries to it are followed by serious defects in the horn. Not only do such easily-recognized conditions as "sand-crack" and "false-quarter" follow injuries to the coronet, but all the defective qualities of horn, such as are found in dry, brittle hoofs, proceed from the coronet. So also do the rings and irregularities often noticed on the front of the hoof.

Growth of Hoof.—The wall grows downward from the coronet at the rate of about an inch in three months. It is constantly growing, and when protected from wear by a shoe, soon causes a disproportionate hoof. If allowed to grow, it may even produce deformity. Remembering this, horse-owners will understand how necessary it is that no shoes should be worn more than about a month without the superfluous growth of horn being removed from the hoof. Farm horses in idle seasons are often grossly neglected by being forced to stand in shoes attached to hoofs so overgrown as to place the foot quite out of its proper relative position to the limb.

Young horses that have never been shod are often injured by being allowed to run in yards or small soft pastures where the hoof is not naturally worn down. Their feet become so overgrown and disproportionate that the limbs are injured and joints twisted permanently. Even foals should be attended to by the farrier when their hoofs become overgrown. No paring is necessary. All that is wanted is the removal of the excess of wall with a rasp. This necessary attention would frequently make all the difference between good feet and limbs and bad ones.

Cartilage.—It is unnecessary to enter more into detail as to the anatomy of the foot. Within the sensitive layer just noticed are the bones, and attached to them the tendons which move the limb in progression. There are two structures, however, which must be mentioned. The chief bone of the foot—the coffin-bone—which gives the general form to the hoof, does not extend throughout its whole interior. It forms the

basis of the front and sides of the hoof, but towards the heels is replaced on each side by plates of gristle or cartilage (fig. 628). This elastic material can be felt at the inner and outer sides of the coronet through the skin of the living horse. When diseased and converted into bone it forms the so-called side-bones, which sometimes cause lameness, and always destroy the natural elasticity of the foot. These cartilages, replacing bone at the back parts of the foot, give resiliency to the hoof, and so prevent concussion.

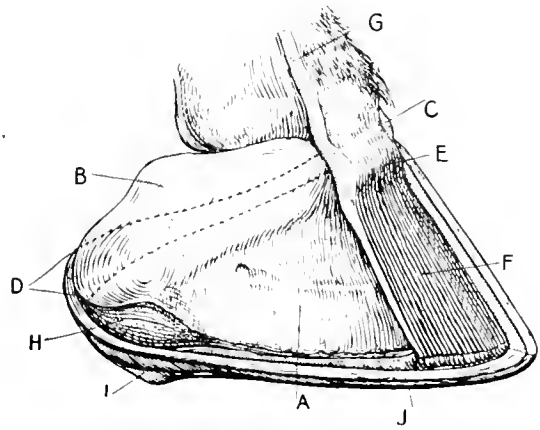


Fig. 628.—Lateral Cartilages, &c., of the Foot

A, Os pedis. B, Lateral cartilage. C, Periplole. D, Peripolic band. E, Coronary cushion. F, Sensitive laminæ, or fleshy leaves. G, Section of skin. H, Fleshy frog. I, Horny frog. J, Horny sole.

The Frog.—If we examine the under surface of the foot, we find another provision against jar, for whilst the sole rests upon a bony basis, the frog does not (fig. 629). The body of the coffin-bone only extends backwards to about an inch past the point of the frog. It there divides into two processes which extend nearly to the heels, but leaving between them a large space which is filled by a pad of elastic material, over which the frog rests. This arrangement permits the frog great freedom of movement, and gives to the back portion of the hoof the special feature of elasticity so necessary to its function of breaking concussion when the foot comes to the ground during progression. The front part of the foot, by the thickness and hardness of the wall, and by the rigid basis of bone within, is specially fitted to sustain the strain which is placed upon it when the toe takes the weight of the horse, as it does in all forward movements. The back part of the foot, by its thinner and more elastic horn, by its prominent and soft frog, and by the partial substitution of cartilage for bone as its inner basis, is specially endowed for receiving its first impact with the ground during progression. That the foot may preserve its functions intact the hoof must be maintained in its best form. No parts must

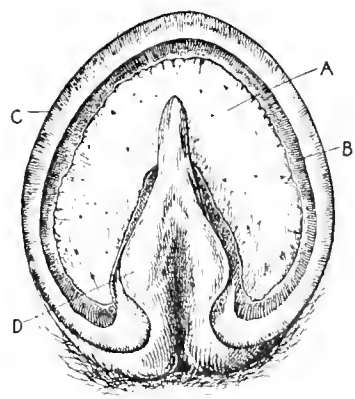


Fig. 629.—Under Surface of the Coffin-Bone, showing its Position within the Hoof

A, Os pedis. B, Sensitive and insensitive laminæ. C, Wall of hoof. D, Horny frog.

be defective, and all must be proportionate. A foot denuded of horn may have its sensitive portions injured, and a foot covered by an excessive or disproportionate hoof may so destroy the balance of the limb as to cause grave lesions, resulting in lameness.

Shoeing is necessary to protect the foot by preventing wear of hoof, but shoeing by preventing wear leads inevitably to excessive growth of horn. Good shoeing, then, entails regular removal of shoes and systematic reduction of the overgrowth of horn. Before a shoe can be properly placed upon a foot, the hoof must be prepared for it, and this operation requires for its skilful performance a knowledge of the normal form of a horse's foot, of the proper proportion of its various parts, and some idea of the right relative position of the foot to the limb.

PREPARATION OF FEET FOR SHOEING

The first step in the operation of shoeing a horse is to prepare the hoof for the shoe. As a rule the hoof is overgrown, and the farrier has to reduce it to proper proportions. He has also to produce a level bearing surface upon which a shoe can rest securely. The first question to determine is, what is the natural bearing surface of the hoof? On soft ground the whole lower surface of a hoof takes a bearing, because the ground yields, and allows the frog, sole, and lower border of wall all to take weight. On hard ground this is not so. The sole is arched, and on a level surface only rests on its abutment with the wall. If we examine the worn part of an unshod foot we find that the border of the wall, with a little of the sole to which it is connected, is marked by contact with the ground, and that the frog also shows evidence of wear. As a shoe is only to protect the hoof these parts are indicated as the natural bearing surfaces, and we follow nature in attempting to produce a similar surface by artificial means. With a rasp the farrier removes so much of the lower border of the wall as will reduce the foot to a proportionate form. He uses his rasp so that a level bearing is formed from the heel to the toe. He must leave as much horn on the foot as is necessary to protect it from injury, and he had better err on the side of leaving too much rather than too little. Some hoofs are so overgrown that their reduction with a rasp is tedious, and a layer of horn all round the circumference of the wall is more easily removed with a hammer and steel blade known as a "toeing knife". Properly used on a strong foot this method is unobjectionable, but on weak, soft feet it is liable to abuse by removal of too much horn. The whole of the superfluous horn must never be taken away with the "toeing knife", as it does not leave a level bearing

surface. The rasp is to be used to finish the process, and as it only obtains a level by further removal of horn, sufficient must be left for it to work on. But a level surface is not the only aim a farrier has to keep in mind. It may be produced with such exactness that a level shoe rests on it perfectly, and yet the hoof may be altogether out of proportion. Both sides of the hoof must be left of the same height, and if the sides of a foot when it comes to a farrier be of unequal height, it is evident that one side must be reduced more than the other to obtain a proper form. Again, it is clear that if the foot be level on both sides, a man may rasp away more horn from one part than another and so cause a disproportion. Carelessness in the use of a rasp frequently leads to unevenness of the bearing surface. From the position in which a foot is held on or between the knees of a farrier, some portions of the hoof are more easily reached with the rasp than others. The left foot suffers by over-reduction of the outside and inside toe, the right foot at the inside heel and outside toe. A left-handed man is liable to injure feet in just the opposite positions. It is equally possible to over-lower both heels or only the toe. Even when the surface is quite even from heel to toe on both sides of the hoof, the foot may remain disproportionate. The heels may be left too high or the toe too long, and the proper adjustment of these two extremities of a hoof is the most difficult and most frequently-neglected part of the preparation of a foot. The great cause of difficulty is the fact that horses' feet are not of definite form, and that much harm may be done by attempting to carve a foot to some ideal standard.

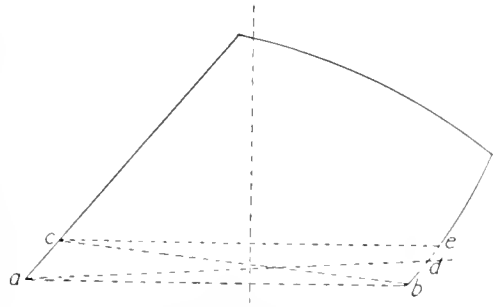


Fig. 630.—Overgrown Foot

a b, Old base of overgrown foot. *a d*, Level surface obtained by lowering the heel more than the toe. *b c*, Level surface obtained by lowering the toe more than the heel. *c e*, Proper angle for new surface.

Some feet have naturally high heels, which can only be reduced to a shapely pattern by weakening their structure. Some feet have naturally low heels, and some have long toes, which must not be interfered with (fig. 631). As a rule, when the overgrown wall is reduced to the level of the sole, very little more horn need be removed. The effects of lowering the heels are to lengthen the bearing surface backwards and to increase the slope of the wall in front. Too much horn at the heels tends to straighten the foot and to lift the frog from contact with the ground. It is always desirable that the frog should touch the ground, but when it is wasted no attempt to let it down by over-lowering the heels should be made.

When a hoof is excessively sloped in front and the toe long, it would be injurious to shorten the toe by rasping the under surface of the foot. Such a hoof is properly treated by directly shortening the toe with a rasp applied to its border.

When a hoof presents broken horn on the lower border of the wall, it is necessary not to allow a shoe to rest on it. Broken horn cannot support weight, and when it yields may cause injury to the sensitive parts, and always causes shoes to become loose. Broken horn should be removed unless it can be left in a position offering no bearing for a shoe. When a foot is insufficiently covered with horn, either as the result of excessive wear from work without shoes or as the effect of previous removal by a farrier, great care is necessary to produce the best bearing surface. As

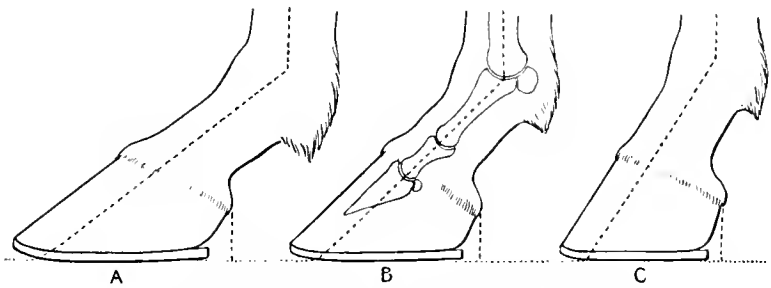


Fig. 631.—Well-proportioned and Ill-proportioned Feet

A, Foot too long and heel too low. B, Well-shaped foot. C, Heel too high.

a rule the quarters of a foot are most broken, and the heels may be trusted to take most bearing.

The sole should never be pared out with the object of making it concave and smooth (fig. 632). All that is necessary is to remove the loose flakes of horn which are naturally being exfoliated. No part of the sole will stand uneven pressure by a shoe, and therefore it must be lowered fully to the level of the wall. The border of the sole, just within the wall, may properly be used as bearing surface, but only in conjunction with the wall. Where the latter is broken away, no attempt should be made to use the sole as a support for a shoe. On flat feet care must be taken, especially at the toe, that the sole is not left unduly prominent. At the heels in all feet the angle of sole between the bar and wall should be left less prominent than the wall, or uneven pressure will take place and cause a corn. The old method of scooping out the sole of the foot till it presented a saucer shape not only left the horny covering too thin to protect the sensitive parts within, but it destroyed the bearing surface for a shoe by leaving the circumference of the hoof a mere narrow ridge. The bearing surface should be as wide as possible, and include not only the wall but the border of the sole.

The frog should not be touched. The broken and ragged portions invite removal, but are better left. They do no harm, and their removal nearly always leads to further loss of horn which is wanted.

The bars should not be cut away, but when they are very prominent may be so reduced that they take no direct bearing on a shoe except at the extreme point where they meet the wall. This extreme point of the bearing surface of a foot is very often injured. What is called "opening the heels" is a favourite operation with some men. It consists in cutting away a wedge-shaped piece of horn from each side of the frog and from the point of the wall. It is altogether evil in its effects, for whilst giving a delusive appearance of width to the heels, it robs the foot of some bearing surface and favours contraction.

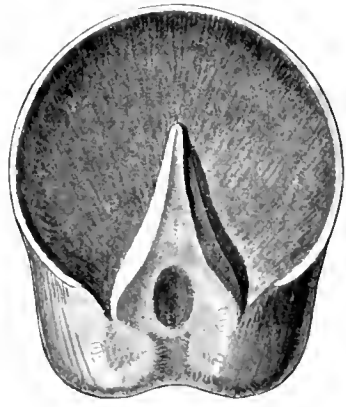


Fig. 632.—A Pared-out Sole

To repeat shortly the rules for preparing a foot:—With a rasp form a level bearing surface for the shoe from heel to toe; keep both sides of the hoof of the same height; see that the length of the toe and the height of the heels are proportionate; let the frog and bars alone; remove from the sole only such portions as are loose or may receive undue pressure from a level shoe; finally run the rasp lightly round the circumference of the hoof, so that no sharp edge be left which is useless to support weight and might be broken.

SHOES

Probably the earliest shoes fixed by nails to a horse's foot were thin iron plates, similar to those now used by Arabs and Turks. The nails were flat-headed, and so soon as the head wore off, the shoe would be loose. On grass land or soft roads this arrangement would afford a fair amount of protection, and the shoe would last a long time by merely refixing it with fresh nails. One of the first improvements would be to increase the thickness of the shoe, and to form the head of the nail so that it might be countersunk into the iron of the shoe and thus afford longer wear.

The great essential in all shoes is that they shall protect the hoof from wear and do no harm to the horse. They should be of sufficient substance to wear three or four weeks, and they should afford a good secure foothold on the surfaces over which a horse travels.

Material.—The best material for horse-shoes is undoubtedly good

malleable iron. Steel is too hard, and favours slipping on stone pavements. Cast-iron is brittle.

Weight.—A shoe should be as light as possible, provided it affords four weeks' wear.

Thickness.—No shoe should be much more than half an inch thick, as the greater the thickness the more the frog is raised from a bearing on the ground. Very thick shoes render it difficult to make the nail-holes of the best size and form.

Width.—The older shoes were all made wide apparently with the idea that the sole needed protection. A weak, thin sole, especially when travelling over loose, sharp stones, may need some extra cover, but a sound sole which has not been robbed of horn by the farrier needs no protection from the shoe. The width of a shoe should depend simply upon the amount of iron necessary to afford four weeks' wear. If a narrow shoe wears out too soon it is better to distribute the additional amount of iron required in width than in increased thickness. A shoe should not be the same width throughout; it should be widest at the toe and gradually decrease towards the heels, as this provides the extra amount of iron where it is most wanted for wear.

The Foot Surface of Shoes.—A shoe has two surfaces—one applied to the hoof, the other for contact with the ground. Both may be quite flat, but there are conditions which govern the choice of form and render advisable some variations. The surface which is applied to the foot must correspond with the bearing surface on the hoof. On all sound, well-formed feet a shoe with a flat surface is the best. The foot surface of hind shoes is always made flat, as is that of narrow shoes for either hind or fore. So long as the sole of a foot is concave no uneven pressure can result from a flat-surfaced shoe, but when the sole is flat or convex there is danger of uneven pressure. Some front feet present this defect, and to provide a safe form of foot surface a shoe is "seated" (fig. 633). This means that the inner half, or more, of the foot surface is levelled so that bearing is confined to the flat outer portion of the shoe. This form of shoe is very commonly used, especially when the shoe is a wide one. Properly made, this foot surface is a safe and useful one. When the outer level portion is made too narrow, useful bearing surface is lost; when it is left a little wider than the wall it is unobjectionable. A very bad foot surface is formed by bevelling the iron so that it slopes from the outer to the inner circumference of the shoe (fig. 634). Such a surface affords no level resting-place for the hoof, and when it is attached to a foot may cause lameness by squeezing the wall inwards. At the heels the foot surface should always be left flat, and the seating of a shoe should

cease about an inch or an inch and a half in front of the extremities of the shoe.

The **ground surface** may vary in form without affecting the foot in any way. The chief variations are such as afford some special means of increasing the security of foothold, and of providing against injury to the

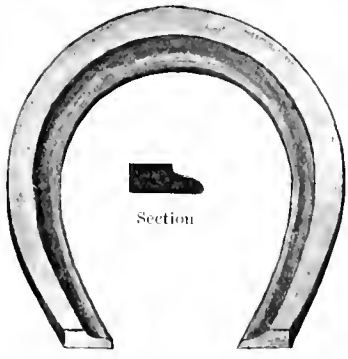


Fig. 633.—A "Seated" Foot Surface

Fig. 634.—A Bad Foot Surface

horse. A flat surface, broken only by a groove or holes for nails, is often used. Ridges or grooves are sometimes added for the special purpose of affording better grip of the road surface. Transverse grooves weaken a shoe and cause it to break more easily than longitudinal ones. What is known as Rodway iron is rolled in bars, having on the ground surface two grooves and three ridges (fig. 635). Into the outer groove the

Fig. 635.—Rodway Iron Shoe with Double Grooves

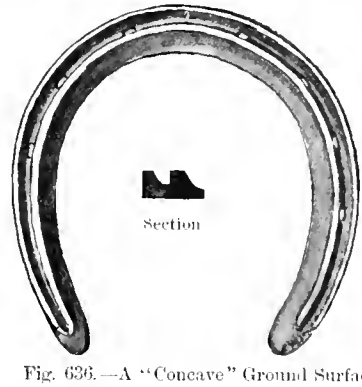


Fig. 636.—A "Concave" Ground Surface

nails are driven. No better form of shoe exists for harness work, provided it affords the necessary wear; but this is just where it fails for the heavier class of horse.

The hunting-shoe is concave on the ground surface, with a groove for the nails round its outer border (fig. 636). This is a good form for hacks and other light horses, as it affords very firm foothold, especially upon the grass and soft roads.

"Calkins" are the turned-down extremities of shoes, which would probably be called heels by non-horsey folk. Projecting as they do from a half to one inch, they afford the most effectual stop or catch where the surface is such that they can sink into it. For the hind shoes of hunters they are quite indispensable, and they are most useful for other classes of horse on soft roads. On some paved streets, where the stones are set with a space between them, calkins afford the best foothold, but on hard, smooth surfaces, such as asphalt, they are quite useless. To provide against wear, calkins are often made too high. Excessive height can be avoided by making the calkin square, and so providing for wear with a lower projection. The evils of calkins are that they put the foot out of its normal position by raising the heel. Thus the toe is subjected to disproportionate wear, the frog is kept from contact with the ground, and to some extent the muscles of the limb are placed at a disadvantage for action.

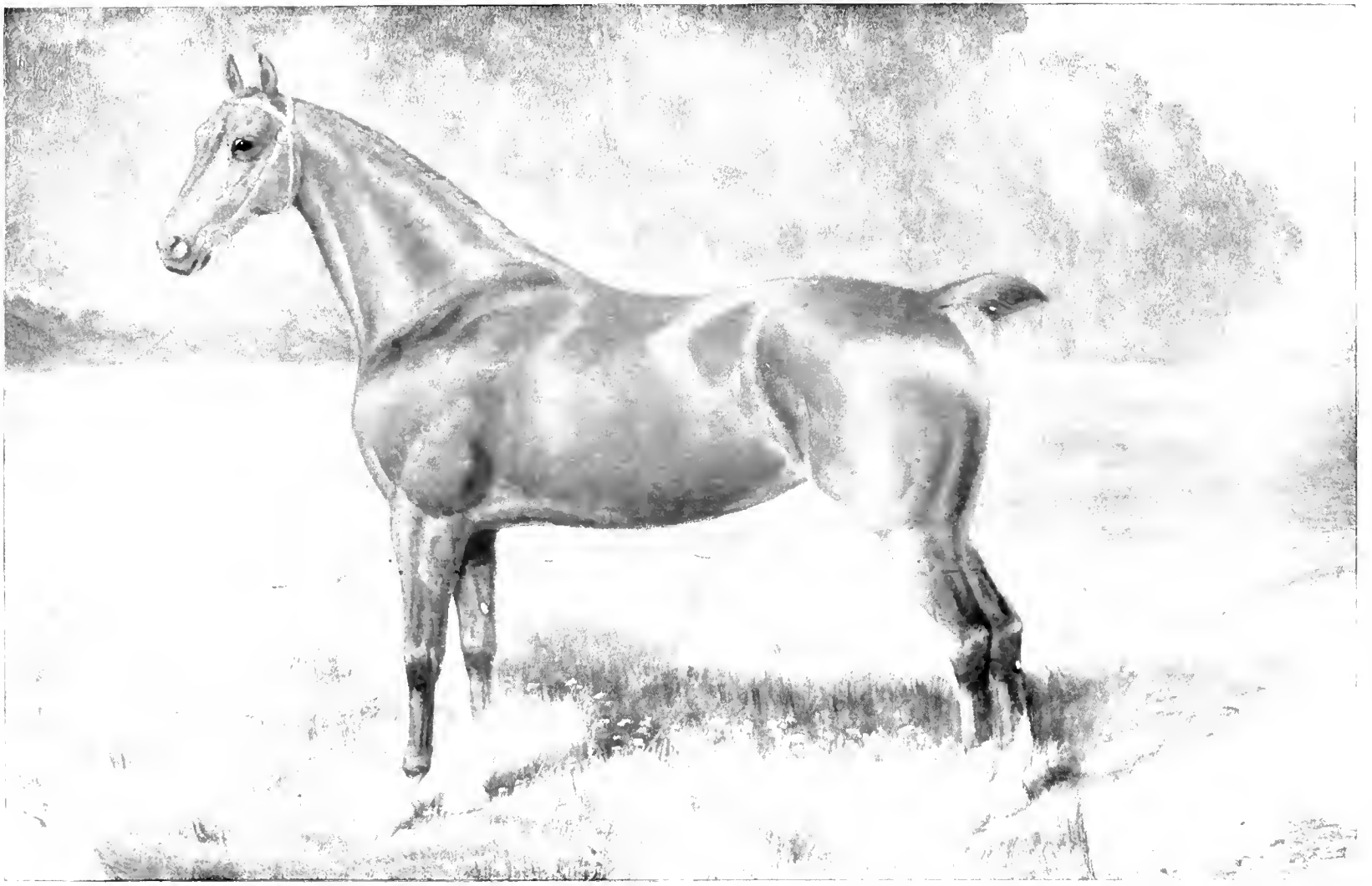
Too high A preferable form

Fig. 637.—Calkins

Toe-pieces.—In Scotland and the north of England heavy horses are shod both fore and hind with calkins and toe-pieces. This form of ground surface on a shoe has some advantages for horses that only work at a walking-pace and have heavy loads to move. The toe-piece consists of a portion of a square bar of iron welded across the toe of a shoe. This, with calkins, makes the shoe more level, and so preserves the proper relative position of foot to limb. The toe-piece affords foothold to the front of the shoe just as calkins do to the back of it, and the combination enables a lighter shoe to be used. It is a good system for railway shunt horses and for animals dragging heavy wagons over paved streets, if the paving-stones have spaces between them in which the toe-piece can find lodgment.

Fig. 638.—Nail-holes

Nails and Nail-holes.—As soon as the head of a nail is worn off, the shoe becomes loose, therefore a flat-headed nail such as a carpenter drives into wood is of no use to a farrier. The horse-shoe nail head must be countersunk into the shoe so that it wears with the shoe and may retain it in position until quite worn out. The nail has a wedge-shaped head. It has a flat shank, because the thickness of the wall into which it is driven is limited. The hole in the shoe must be made to fit the head of the nail, and as the size of nail most suitable for a hoof varies considerably, it is necessary to make the nail-holes in a shoe very care-



HACKNEY MARE, LADY KEYNGHAM

Sire, Dare-devil 174 ; dam, 2019 Dorothy by Lord Derby II 415. The Property of Sir W. [illegible], Bart.

fully correspond to the head of the proper sized nail. Nearly all hind shoes and some front ones are provided with nail-holes by stamping through them a series of four-sided tapered holes of the size required. Most fore-shoes are "fullered", *i.e.* a groove is sunk round the shoe close to the outer edge, and through this the holes for nails are afterwards punched. Both methods admit of nails being easily driven with safety. The number of nail-holes really required to retain a shoe should vary with the size of shoe. Never more than eight are required. Usually seven are sufficient for the largest shoe. Small shoes are safely retained by six. The position of nail-holes is important. The wall at the heels is thin, and therefore if good hold of the front portion of the foot can be taken it is unwise to drive any nails at the back part. Nail-holes should not be too near to the outer edge of a shoe, as when the nail is driven insufficient hold is afforded it, and the hoof is likely to be split.

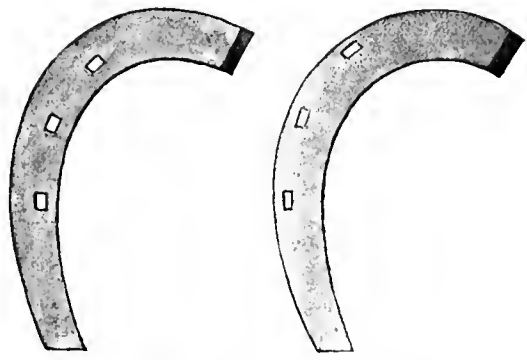


Fig. 639.—Wrongly-placed Nail-holes

Still more important is it that nail-holes should not be placed too far from the outer edge of a shoe, as then a nail is forced to approach too near the sensitive structures within the hoof. The nail-holes at the toe may be a little "coarse", but the holes at the heels must be "fine". The "pitch" or direction of a nail-hole is important, because it controls to a great extent the direction in which a nail can be driven through it. The safest "pitch" for a nail-hole is straight through the shoe, but the holes at the toe should have a little inclination inwards, as the wall at the corresponding part of the hoof slopes considerably, and the nail must follow its direction.

Fig. 640.—Pitch for Nail-holes for Quarters

Fig. 641.—Pitch for Nail-hole for Toe

Prepared Bar-iron.—Formerly only plain four-sided bars were supplied for farriers. Now manufacturers roll bars with flat or seated foot surfaces, and with various forms of ground surface. These prepared bars only require to be cut into proper lengths, turned round, and holes punched for nails to form a very good shoe. For harness horses the double-grooved (Rodway) bar is very handy and very serviceable. For

hunters, bars can be had ready fullered and concaved. For hind shoes of hunters a very good prepared bar is made, which, being rounded on two edges, affords a shoe without trouble that guards against over-reaches.

Machine-made Shoes.—All sorts of shoes are now supplied ready for nailing on, made entirely by machinery. For front feet these shoes are all that is wanted, but for hind feet the best hand-made are still unequalled. No doubt engineering skill will soon be able to supply a hind shoe which will last a month on a hard-wearing horse and yet not be heavy and cumbersome. There will be a large demand for such a shoe when it appears.

FITTING SHOES

Care in Fitting.—Very few horse-owners appreciate the importance of care and exactness in fitting shoes to horses' feet, and yet this part of the operation of shoeing may render a perfectly-formed shoe an instrument of torture, and cost the owner more than the price of a hundred sets of shoes.

Too much care in fitting the shoe to the foot cannot be taken, and as care means time, the folly of valuing shoeing by its cheapness will be evident. Cheap work is done by unskilled men or by skilled men in a hurry. Under either condition it cannot be careful and exact, therefore the horse suffers. One reason why bad shoeing is tolerated is that its evils are not always immediately indicated, and then the results are credited to other causes. Quite a third of the ill effects to horses' legs that are supposed to be due to hard work are really the result of injury to the feet. The grosser injuries cause acute lameness and are detected, but the finer injuries cause only tenderness and discomfort, which is overlooked, and so continued for months. The effects are seen in bent knees, shot fetlocks, loss of action, and a shuffling gait, which combined shorten the profitable working lives of horses by years. And yet horse-owners will invite this for the supposed economy of eight or ten shillings a year on their shoeing bill!

Having brought the hoof to the best form and proportions, the farrier selects a shoe suitable for it in size, weight, and shape. His next duty is to alter it so that in every detail it shall be exactly adapted to the foot upon which it is to be nailed—in other words, he "fits" it to the foot. There are two distinct objects to be achieved in fitting. First, to make the outer border of the shoe correspond to the circumference of the wall. Second, to make its foot surface rest evenly and closely on the bearing surface of the foot. Feet differ in shape; some are nearly

round, others nearly oval, whilst many are very irregular, but they are never geometrical figures. Were there a definite form, shoes might be cast in a mould and applied without special fitting. The more ignorant of the hundreds of inventors of horse-shoes are quite unaware of this, and hence the stupid but plausible claim that their shoe "may be fitted to the foot by a groom or stableman". The fact is, every shoe must be fitted to the foot upon which it is to be fixed, and in this is the great art of the farrier's trade.

Circumferential Fitting is the adaptation of the shoe to the length and breadth of the hoof, so that the wall of the foot may rest firmly upon the shoe throughout its whole bearing surface. In producing this "fit" attention must be paid to the nail-holes, so that they are brought into the safest and best position for the nails to be driven through into the horn. The outer border of the shoe should correspond exactly with the circumference of the wall all round, except perhaps at the heels. In horses doing fast work the shoe should be fitted close, even at the heels, and especially on the inside of the foot. The outer side of the foot may be always fitted a little "fuller" or wider than the inside. The heavier horses may have the heels of a shoe fitted wider than the hoof, and this especially when calkins are used, because a firmer base of support is given by a shoe when the heels are wide than when they are narrow. A shoe should always be fitted full to the foot, *i.e.* not within the edge of the wall. When shoes are fitted close, and neatness of appearance valued as highly as sound work, there is a tendency for men to make the foot fit the shoe. This is done by roughly and carelessly approximating the border of shoe to the border of foot, keeping the shoe a little within the edge of the wall, and, after nailing it on, levelling the work by rasping away any prominent horn. In some strong, well-grown feet this may do no harm, but it is a bad habit, certain to do injury when a weak foot is being operated on. The length of a shoe is important. It should be the full length of the bearing surface of the foot. When longer it may injure the horse's elbow when he lies down, and on the front foot may be struck by the hind shoe and pulled off. The fore shoes of hunters are always fitted short to avoid this (fig. 642), but in many cases they are unnecessarily short. A short shoe is objectionable for many reasons—it loses some of the natural bearing of the foot, it is likely to cause a corn by bruising the sole at the heel, and it carries forward, out of its proper relative position to the limb, the base upon

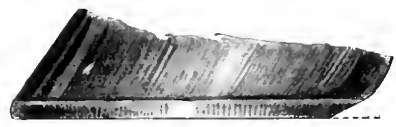


Fig. 642.—Shoe Fitted Short at the Heel

which the horse stands. On a hind foot there is no excuse for fitting a shoe short. It stands no risk of being pulled off by another foot, it cannot injure any part of the limb when the horse lies down, and so the hind shoe should always be longer than the foot, especially when calkins are used.

Fig. 643.—An "Eased" Heel

Surface fitting is the adaptation of the plane foot surface of the shoe to the level bearing surface of the foot. The shoe should rest evenly upon the hoof from toe to heel, the pressure being uniform throughout. Should either the foot or the shoe not be level some parts lose bearing, and others sustain an uneven and excessive bearing. It is not uncommon to find a shoe fitted so that its centre is higher than either heel or toe. Such a shoe rests unevenly on the quarters of the foot, and as the wall is there weak, we often find the horn broken as the result of excessive bearing. Flat feet present the sole more prominently at the toe than at other parts, and therefore care is required, when fitting shoes to them, that the inner edge of the toe of the shoe should not bear upon this part.

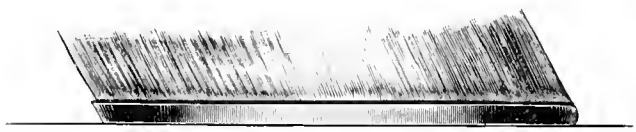


Fig. 644.—Shoe with Level Bearing

Special care must always be taken to avoid any undue or uneven pressure by the heels of a shoe upon the angle of sole between the wall and the bars. When the horn of the wall is detached from the sole or badly broken, it must be relieved of all bearing either by lowering it with the rasp or by fitting the shoe so that there is no contact between the two. A very injurious method of fitting shoes followed upon an erroneous theory to the effect that the heels were unable to stand their share of bearing as well as other parts of the wall. With a view to save the heels of the foot, shoes were what is called "eased" or "sprung" at their extremities (fig. 643). This system of fitting left a space between shoe and foot at the heels into which the blade of a knife might be passed, and the space extended forward from an inch to an inch and a half.

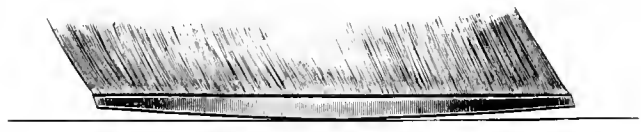


Fig. 645.—Shoe Imitating a Worn Ground-surface

The fact is that the heels will stand, and they require, all the bearing a level shoe can afford. The "eased" heel is altogether an injurious thing. It loses bearing surface, and concentrates pressure on the spot where

foot and shoe come into contact. Instead of affording ease, it causes an on-and-off pressure every time the foot is brought to the ground during progression. The surface fit of a shoe should be an even and level one from toe to heel.

Hot and Cold Fitting.—Shoes may be fitted either hot or cold. If fitted cold, exactness can only be attained by the same long process that is adopted by an engineer who has to fit together two pieces of metal. All shoes have to be altered to fit a foot properly, and they cannot easily be altered cold. That exactness of fit cannot be obtained by cold fitting is amply proved by the number of loose shoes that occur when it is practised, to say nothing of the injury to horses' feet from uneven pressure. An iron shoe is easily altered when hot, and this advantage requires the accompaniment of very grave disadvantages before it can be shown that it is wrong. Counterbalancing disadvantages do not exist, and therefore all argument is in favour of hot fitting, in addition to the weight of universality of practice. Hot fitting facilitates the exactness of fit, it decreases the time necessary for fitting, it does no harm to the hoof, and it undoubtedly results in greater security of the shoe. Opponents assert that hot fitting leads to excessive burning of horn, but this is only an abuse of the method, and does not occur in the hands of a good farrier. When a skilled workman has selected a suitable shoe he heats it in the fire, compares it with the foot, alters it on the anvil, and then applies it to the hoof for a few seconds. Wherever the shoe touches the horn it leaves a mark, and thus shows all irregularities. If the horn is at fault a touch with the rasp corrects it, if the shoe is at fault it is taken back to the anvil and altered. In this way exactness of fit is soon attained and the hoof uninjured. The abuse of hot fitting takes place when a hot shoe is retained on the foot until it beds itself into the horn. There is no excuse for this practice, which is a sign of slovenly work, and may be a source of injury to the horse.

Clips are thin projections drawn from the iron of the shoe at the toe or quarters for the purpose of giving stability to the shoe when on the foot. By many persons they are looked upon as essential for the prevention of shoes shifting on the foot. On some horses, from peculiarity of gait, shoes have a tendency to shift inwards. This may be prevented by a clip on the outside of the shoe. The tendency of a foot to slip forward on a shoe is rare, and yet clips are in Britain always used on the toe of the shoe. The fact is, the toe-clip assists the farrier to fit the shoe, and it gives steadiness to it whilst the first nail or two are being driven. Clips should not be long and narrow, but rather wide and short. They should be thin, and drawn with an inclination corresponding to the

portion of wall against which they are to rest. Too often a large piece of horn is dug out of the toe to make room for the clip. This is altogether unnecessary, as all that is required is to form a level surface on the horn with a rasp, so that the clip may lie evenly and not project. When the shoe is nailed on the foot a few taps with the hammer are required to leave the clip close, but the violent hammering too often seen is dangerous, and usually due to the clip having been badly drawn.

When two side clips are used and both excessively hammered, lameness results from the pressure on the wall.

NAILING ON THE SHOE

Nearly all horse-shoe nails are now made by machinery. They are well made, sound in structure, properly pointed, and with heads of a uniform size and shape. The machine-made nails are certainly better than the hand-made, and no fault can be found with them so long as the iron from which they are manufactured is good. A horse-shoe nail must be made of the very best iron, or it will break and cause shoes to be lost. According to the size of a foot so is the thickness of horn, and nails are chosen to suit this. Too large a nail breaks the horn, too small a one fails to hold the shoe on. The direction in which a nail is driven is very much controlled by the form of the nail-holes in the shoe. When a farrier finds that he cannot drive a nail with safety he should either have the shoe altered or decline to drive the nail. The direction which a nail takes in the horn is recognized by the sound and "feel" elicited by the hammer. In a thin foot it is a delicate operation, but in a strong hoof there is no risk whatever. The heads of nails when driven should fit the holes or fullering of the shoe. A small portion of the head should be visible when the nail is driven home. When the head is only flush with the surface of the shoe, and visibly does not fill the hole, the shoe is likely soon to be loose.

When a nail is driven through the hoof, its point is turned down and wrung off, so that a protruding portion is left. This is called a clinch. Just under it a notch is made in the wall with a rasp, and the clinch gently hammered down into it. A stroke or two of the rasp levels the whole and leaves the clinches smooth. Excessive rasping weakens the clinches and destroys the security of the shoe. When the shoeing is finished the clinches should be seen about equidistant from each other, with a good hold of the wall, and rather higher at the toe than at the heel.

ROUGHING

In winter some addition to the ordinary shoe is necessary to prevent horses from slipping on ice and snow. In Great Britain the weather is so changeable that a regular provision for frost is seldom made, as it is in countries where ice and snow prevail for weeks or months at a stretch. Here our roads are covered with ice and snow with very little notice, and may be free again in a day or two. Horse-owners therefore provide

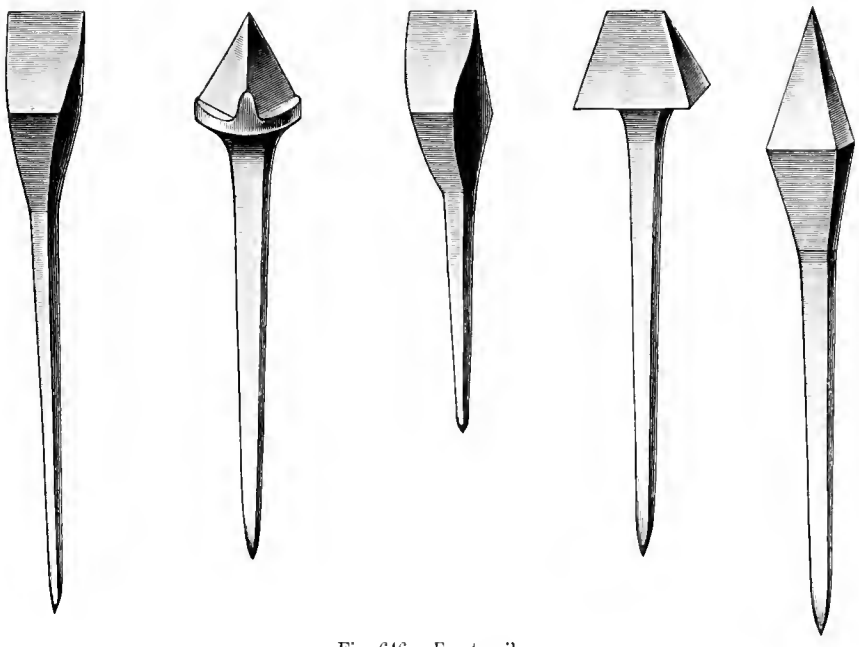


Fig. 646.—Frost-nails

temporary arrangements to meet the short, occasional spells of slippery weather. The most temporary method of affording foothold is by the use of what are called frost-nails. These appliances are very similar to the ordinary horse-shoe nail but with a larger head, and brought to a sharp point or to a chisel-edge. The smaller ones may be driven into the holes from which a nail has been removed. The larger are only used at the heels in an extra hole specially provided for them. These holes are punched through the heels of the shoe, which is fitted a little wider than usual, so that a frost-nail when driven does not enter the hoof at all, but passes through the shoe, and is fixed by being twisted over the shoe. Frost-nails are very useful for an emergency, but not for continued use.

When frosty weather looks as though it were to continue for some

time, horses are "roughed" or "sharped". The shoes are taken off, heated in the fire, and the heels turned down so as to form a sharp projection that will cut into ice or frozen snow, and so give firm foothold. On hard roads this sharp projection soon becomes worn away, and the process of roughing has to be repeated. This repeated removal of shoes injures the feet, not only by the driving of nails through old holes, but by the shortening of the shoe, necessitated by the roughing. So injurious is repeated roughing, that a better but more expensive method is now adopted by all sensible men who have horses of value that must continue at work during frost and snow. From about the middle of November to the middle of March sufficient frost to render roads unsafe may at any time appear. To meet this the shoes, before being put on, are furnished with holes at the heels, or both at toe and heel. These holes

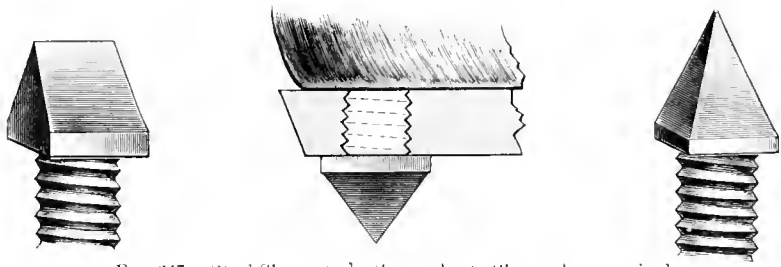


Fig. 647.—Steel Sharps to be Screwed into Shoes when required

are made with a thread, into which movable steel sharps can be screwed when wanted. To keep the holes clear a cork may be screwed into them, or better still, square steel plugs may be used during ordinary weather, and replaced by the sharps when frost arrives. No removal of shoes is required by this method, and no sharp projections need be left in the shoes when the horses are in the stable.

INJURIES FROM SHOEING

When a horse has a good foot and shoeing is properly done, no harm to the horse results from the repetition of the operation every month for his whole lifetime. Accidents may happen, but to speak of shoeing as "a necessary evil" conveys a very incorrect notion of its value. To do the work without shoes that is now done by horses with shoes would require twenty times the number of horses at present in use, and more than half of the whole would be lame at frequent intervals from injury due to wear of the hoof. The British army keep very strict notes of everything which causes a horse to be unfit for duty. The strength on an average is 16,000 horses, and the injuries from shoeing only 150

per annum, of which 50 are due to nails. These statistics show unmistakably that army-shoeing is carefully done, and there is no reason why the work should not be done equally well in civil life. The direct injuries resulting from shoeing may be classed under three heads—those resulting from nails, those from clips, and those from irregular pressure of the shoe.

Nails.—Lameness may be caused by a nail being driven too near the sensitive foot without absolute penetration of the "quick". This cause of lameness is called "a bind", and may not be evident for a day or two, or even a week, after the time of shoeing. In every lameness of the horse which cannot be accounted for by a visible lesion the foot should be examined, and especially when it is noticed within a few days of shoeing. To detect a foot-lameness the shoe must be removed and the hoof tested all over by firmly pressing it with pincers. When a "bind" is detected before lameness is very acute, removal of the offending nail, rest, and warm fomentation are sufficient to prevent further injury. When a "bind" is allowed to continue, inflammation is set up in the foot, and pus may form. Then a serious condition exists which requires veterinary attendance. Another form of injury results from a nail being driven directly into the sensitive foot. This is usually followed by immediate lameness, but its gravity depends upon the extent of injury, and upon whether the nail carries with it any dirt or septic material. As a rule the farrier knows when he has "stabbed" or "pricked" a horse, and withdraws the offending nail at once. If suppuration does not follow a prick its effects are very temporary, but the formation of matter within the hoof leads to very grave results, in some cases to a fatal termination. Continued work is the greatest aggravation of injuries caused by nails, and therefore all such cases should be attended to at once, and rest strictly enforced.

Clips may cause lameness by being hammered down too tightly. The most serious injury traceable to clips occurs from a shoe becoming loose and only partially detached from the foot, so as to permit a horse to tread on the clip. A large punctured wound results, which may endanger the animal's life. Rest and perfect cleanliness are essential to recovery.

Uneven Pressure of the Shoe causes the sensitive foot to become bruised. The sole of a flat foot is frequently bruised by pressure of the shoe just behind the toe. When detected early enough removal of pressure is all that is necessary. The most common seat of injury, due to bruising by the shoe, is the inner heel of the fore foot. This is known as a "corn", but is in no way analogous to the condition on human feet described by the same word. A "corn" in the horse is simply a bruise of the sensitive foot resulting from uneven pressure by the heel of the

shoe. The injury causes lameness, and is accompanied by staining of the horn by effused blood underneath. An open, flat foot is most liable to corn, and the shoe most likely to cause it is one that is fitted too short and too close. Even a well-fitted shoe may cause a corn when it is allowed to remain on the foot too long. As the hoof grows the shoe is carried forward, and the extremity of the iron is shifted from its safe bearing on the wall to a position which allows it to impinge on the seat of the corn. The excessive retention of shoes frequently leads to their being forced outwards, and then the inner heel is brought over the sole on the inside, and bruising results.

The gravity of a corn depends upon the sensitive sole. In slight cases removal of the shoe and its readjustment, so that no pressure on the bruised part can occur, is sufficient to ensure a return of soundness. Sometimes a day or two's rest and warm fomentation of the foot are necessary. In more aggravated cases it is right to suspect the formation of matter at the bruised part, and as this is a serious condition within the hoof, it is necessary to pare away all the discoloured horn, and thus afford an opening through which matter may escape. In cases of corn where the discoloration of horn is not very great, and where lameness is not excessive, it is inadvisable to cut away all the horn over the bruised part. Horn takes time to grow again, and its absence spoils the bearing surface of the foot. In very many cases a simple bruise, that would have recovered in a few days by merely relieving the pressure of the shoe, is made a source of injury and of recurrent lameness by the unnecessary removal of all the horn between the wall and the bar. When a slight corn is found with slight lameness, relief of pressure is easily given by cutting off the inner heel of the shoe, thus forming what is called a three-quarter shoe. This removal of iron is a safer and better plan than removal of horn.

Fig. 648.—Three-quarter Shoe

Uneven pressure by a shoe may take place at other parts of the hoof. A badly-fitted shoe very frequently bears disproportionately on the quarters, and the wall becomes weak and broken. In such a case relief is given either by lowering the wall or by adjusting the shoe so that heels and toes for a time afford the only bearing.

In all cases where a separation exists between the sole and wall, bearing must be avoided, as the wall, when unsupported by a firmly-

connected sole, is unable to sustain its share of weight. In cases of "seedy-toe" this must be remembered. Where a "sand-crack" exists, pressure should be removed from the wall. If the sand-crack be at the toe a good plan is to draw two clips on the shoe, one on each side of the crack, and then to lower the wall between the clips so that it has no contact with the shoe. With a sand-crack at the toe the heels should

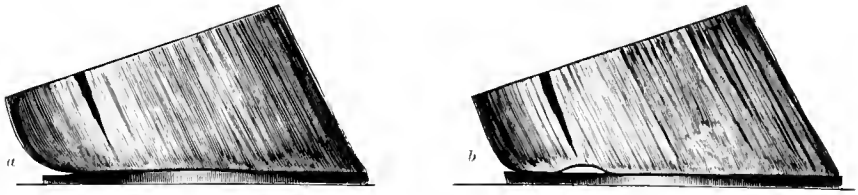


Fig. 649.—Sand Crack, showing Method of Paring the Crust

a, Bearing relieved at wrong place by "springing" the heel. *b*, Horn removed to prevent pressure

be kept low and no calkins used, as the higher the heel is raised the more pressure is thrown upon the front portion of the foot. When a crack exists at the quarters the wall just under the crack must be removed from bearing, but it is of the greatest importance that the heel of the shoe should have close contact with its horn behind the crack.

"Cutting" or **"Interfering"** are the terms applied to the act of striking the fetlock of one limb with the shoe of the opposite limb. Every horse-owner imagines such an accident to be the fault of the farrier, and every farrier fancies he has a system of preventing or curing such injury. I must, of course, allow that the shoe inflicts the blow, but I am quite convinced it is a passive agent, and that in 95 per cent of cases no fault of the shoe, either in form or fit, can be shown to have occasioned the injury. "Cutting" is practically confined to young horses out of condition, or to old horses suffering from debility. It may also take place in tired horses. Of course, a shoe excessively prominent on its inside will facilitate injury to the opposite fetlock, and it is therefore right to fit the shoe close with a view to prevent or cure cutting. It is not right, however, in any case to rasp away the whole of the wall on the inside toe, and such a proceeding never yet stopped a horse from cutting. It requires about two months to get a green horse sufficiently into condition to stop him hitting his legs. During this time he should wear pads or "Yorkshire boots". His

Fig. 650.—Shoe for Cutting, showing Position on the Foot

shoes may be fitted close, but the wall of his foot should not be damaged. As he gets into condition he will cease striking his fetlocks, and whatever curious form of shoe he happens to wear when he begins to go strong and cleanly will get the credit of a cure, although it had nothing to do with the change.

The hind fetlocks suffer more from cutting than the fore. This is due to the different form of shoe used quite as much as to the form and action of the limb. The hind shoe has calkins which interfere with the proper relative position of the foot to the limb, and so cause imperfection in the gait. Nothing so speedily stops cutting behind as removal of calkins and the use of a level shoe. It is not the calkin that hits

Fig. 651.—Shoes for Cutting

the opposite fetlock. In very few cases is the heel of a shoe the offending part. It is the inside toe which strikes, and this proves that the injury results from defective action and not from prominence of the shoe.

It has been found that a three-quarter shoe does good in cutting. It does so, not because the heel was the offending part, but because the movement of the foot is modified by the altered form of the shoe. The practice of raising one side of the foot higher than the other for the prevention of cutting is very widely adopted, and plausible theories are framed as to its effects. Sometimes it is argued that the injured fetlock is thrown farther outwards, and sometimes that the offending foot is made to move farther away from the opposite leg. The practice is not always successful, and the theory wants a true basis of facts. Not one horse in a thousand "cuts" when in good condition, and nearly every horse does when out of condition. Patience, good feeding, and regular work are better treatment for cutting than all the usual alterations of foot and shoe.

Over-reach is an injury to the heel of a front foot by the shoe of the hind foot of the same side. It is not the outer edge of the hind shoe which strikes, it is the edge on the inner circumference of the toe of the shoe. To prevent over-reaching, the hind shoe must be so altered that the offending part is rounded off. As the accident only occurs

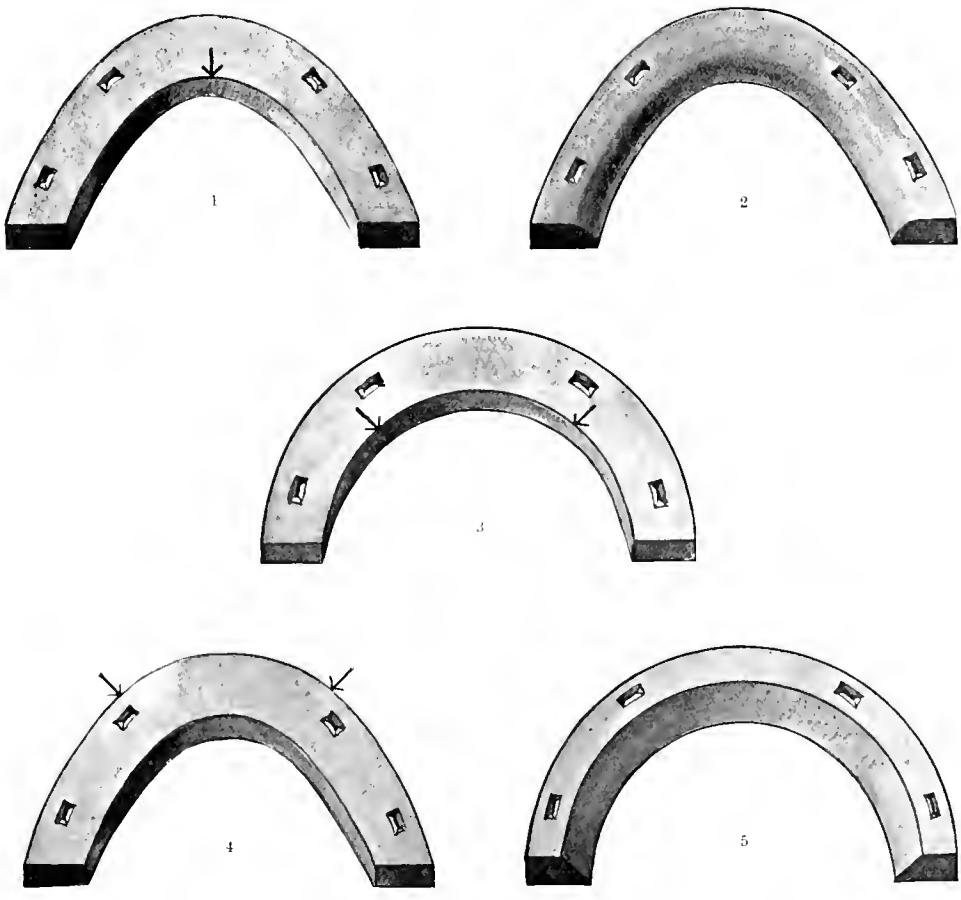


Fig. 652.—Over-reaching, Forging, and Clacking

1, Toe of hind shoe, showing the edge which cuts the heel of fore foot. 2, Toe of hind shoe, showing rounded inside border. 3, Toe of fore shoe, showing places struck in forging. 4, Toe of hind shoe, showing the edge which strikes the fore shoe. 5, Toe of hind shoe with inner border bevelled off.

during the fastest paces it is confined to hunters and trotters, two classes of horses which ought always to be shod with hind shoes having rounded edges on their inner toe circumference.

Clacking, or **Forging,** is the noise made by horses trotting when the hind shoe strikes the fore. It is not the heel of the front shoe that is struck, but the surface of the shoe just behind the toe, so that the foot is in the air at the time of striking. The part of the hind shoe

that strikes is not the extreme point of the toe, but the edge on either side of the toe. Young horses out of condition, and long-stepping, careless goers, are usually the animals that "forge". To prevent it the front shoe is made concave on the ground surface, and the calkins may be removed from the hind shoes. Quite as important as alteration of the shoe is alteration of the horse's gait. He should not be driven "past his pace", and he should be made to go up to his bit. Patience, condition, and coachmanship are as necessary to stop "clacking" as a good farrier.

THE TRANSIT OF HORSES

SECTION XIII.—THE TRANSIT OF HORSES

SEA CARRIAGE

There is every reason to suppose that the horse was very early in the world's history compelled to carry man, but when the latter first devised means for the conveyance of horses is not known.

Potentates both great and little were from the earliest times the recipients of presents in the shape of horses from distant lands, and sea carriage appears to have long preceded the horse-box upon wheels.

Ships capable of conveying Hannibal's elephants from Carthage to the Spanish peninsula may well have carried horses, but they do not receive any mention in connection with that great general's disposition of the sea forces which landed upon Mediterranean shores, to dispute with Rome for the mastery of the world.

Viewing the shipping arrangements of to-day, one can scarcely believe there has been much improvement, save in the matter of ventilation.

The great passenger ships by which private individuals usually convey favourite horses offer no special accommodation; there are no stalls or permanent fittings on the Peninsular and Oriental Company's steamers, for instance, although they frequently carry horses of great value, both east and west. The site usually assigned to horses is in the ship's waist, where the greatest amount of protection from the weather is ensured. Here they are enclosed in a narrow wooden box some 7 feet by 2 feet 3 inches, the sides of which are 6 feet high. At one end is a door whence the manure can be removed, and outside the other end a small manger fits into iron slots. Beyond a little trap-door on a level with the floor there is no provision made for drainage. The urine escapes from the box as best it may, finding its way from the deck to the scuppers, and out through the holes provided on all vessels for the escape of water. The horse is not led aboard as in the regular cattle ships, but is boxed on the quay, and then, by means of slings attached to semicircular iron bars placed equidistant above him and from the ends of his prison, he is raised by the steam crane or derrick, and lifted aboard as deftly as might be a lady's bandbox. In

this position he has sometimes to remain the whole of the voyage. In cold and foul weather a tarpaulin is thrown over the box as it stands on the open deck. Horses bound for the East suffer more from the heat in the Red Sea than from the inclement weather so often experienced in the Channel and the Bay of Biscay. It is therefore necessary, in exporting horses to India and other hot climates, to make special arrangements with regard to clothing. In this journey a change from warm to light cool rugs will be required on reaching Port Said, and if practicable the horses should be removed to the cool and sheltered side of the ship, which in this case will be the port bow. When weather permits advantage should be taken of every available opportunity to give exercise on deck, so that any undue filling of the legs may be obviated, and relief afforded from the cramp and fatigue of long standing. It will be well, too, to bear in mind that much relief from the discomfort arising out of these causes may be afforded by the repeated application of friction to the surface of the body and vigorous hand-rubbing of the legs. Except when the animal is at exercise bandages should be worn and applied with a fair amount of tightness, so as to support the joints and sinews and prevent swelling.

The vessels which bring so many horses from America carry them between decks. A number of stalls about the same width as the box previously described are arranged on both sides of the ship, the animals facing inwards. They are not slung, but the length of the stall is not sufficient to include the head and neck, which protrudes over the gangway, and it is therefore impossible for an animal to get down. Each animal is fastened with the usual halter or head-stall, which is long enough to permit him to feed from the level of the deck or floor of the gangway, where the nutritious alfalfa hay is strewn.

The stout planking that runs breast-high in front of the stalls is screwed up with bolts, and, in case of a sick animal having to be removed, it must needs be cut away for a space. The planks which divide the stalls are made to drop into iron receptacles, and have only to be lifted out when the horses arrive at their destination. To prevent slipping there are bars across the floor of the stalls, but no bedding is provided, as being unnecessary and likely to hinder drainage. A gutter is provided in those vessels specially constructed for the transatlantic horse trade, and that it effectually carries away the urine may be presumed from the comparatively pure air and freedom from ammonia which prevails on these ships on arrival with a cargo of live stock.

The arrangements for disembarkation leave a good deal to be desired, the movable gangways being too long, and most of the animals strike their polls and at first refuse to mount the ladder. Another shoot or portable

gangway over the ship's side enables them to reach *terra firma*, which they do with evident satisfaction, for though they are often cramped, and occasionally the victims of fever in the feet, one cannot have associated with horses on a voyage without observing the pleasure they display on once more getting ashore.

Diet.—Diet on ship-board requires to be carefully adjusted. Bran and sweet hay should form the staple food; a little corn may be added, but the less the better. A daily allowance of 4 or 5 lbs. of carrots will keep the body cool and the bowels in free action, besides which they are a wholesome and refreshing addition to dry aliment.

In passing through hot climates horses should be watered at least four times a day, and occasional sponging of the face will add materially to their comfort.

Medicines.—When long sea journeys have to be taken by valuable horses every provision should be made for dealing with diseases and accidents which may occur on the voyage, and full instructions should be given to the attendant how to act in certain emergencies. Among other things he should be furnished with a clinical thermometer, and exercised in its use before starting. Suitable needles, carbolized thread and cord, should also be provided for stitching up wounds, as well as a stock of antiseptic wool for dressing them in the course of subsequent treatment.

These, together with the following list of medicines, will be found to meet all the ordinary requirements likely to arise in the course of a voyage:—

Nitrate of Potash Powders.	Mustard.
Physic Balls.	Antiseptic Lotion for Wounds.
Fever Draughts.	Stimulating Embrocation for Sprains.
Colic Draughts.	Jar of Vaseline.
Cough Balls.	Pot of Zinc Ointment.

In some horses of excitable temperament it may be found necessary to inject a little morphia beneath the skin now and again until they settle down to their new mode of life.

Necessity may not arise for the use of any of the more active medicines, but where horses are confined for long periods in a standing posture a little nitrate of potash powder given in the food every second or third day will be found of distinct advantage in correcting any tendency that may arise to filling of the legs.

Horse Boats.—On short voyages, like that from the mainland to the Isle of Wight, horses are conveyed in barge-like boats with a floating platform at the stern, corresponding to the tail-board of a cart. However calm the sea or river to be crossed, there is always a difficulty in getting horses

aboard, as they intuitively dislike an unstable platform, and an old stager has to be kept as a "leader" to induce novices to follow.

Once on board they are packed closely together, and linked as well as fastened singly to the bulwarks.

Horses taking a long sea voyage should have their hind shoes removed, and tips applied to the fore-feet.

LAND CARRIAGE

Horses are carried on land in "floats", railway boxes, and trucks. The first vary in different districts, but the main principle is that of a box on low wheels, in which sick or injured horses may be carried. Entrance to these useful conveyances is obtained from behind, where the door, on being let down, forms a gangway with very slight ascent, along which the horse is led into the float.

The horse-box familiar to most travellers, at least from the outside, is divided into three compartments, every portion of which appears to have been designed with the special object of making the most alarming noises calculated to frighten the inmates.

The same description applies with even greater force to the doors, which open upon the platform, or "dock" as it is called. It is too heavy for a man to let it down steadily, and the traditions of the railway would be altogether violated if it were not allowed to fall with great violence upon the siding. Everything about a horse-box comes undone with a jerk and closes with a bang. Some horses absolutely refuse to enter a box of the kind, and much might be done to render them less fearsome to those unaccustomed to travel.

The youngster is frightened at the outset by the sound of his feet on the wooden frame door, which might just as well be "dead sounded" by an intervening substance that would absorb sound, or an india-rubber floor. The means of securing horses when in the box is also objectionable.

In this connection Professor Axe, writing in the *Live Stock Journal Almanac*, observes:—"No one having acquaintance with the construction of our horse-boxes during the past thirty years will fail to recognize how very meagre have been the alterations and improvements which have been effected in them during that period; but what is still more important is the striking want of uniformity, and obviously dangerous methods, which continue to be practised throughout the various systems in the fastening or tethering of travelling horses.

"That our railway companies, with all the experience before them, should have failed to develop a reasonably safe system out of the half-dozen

methods or more now in vogue is by no means reassuring to the horse-owning public, and so long as such divided opinions and practices exist, so long may we expect accidents to continue, and litigants to press the advantages of one system in order to fix blame on another.

"In tethering horses in boxes the general practice at present adopted is to engage two stout ropes and a head-stall. The former are tied in various ways, not only in the service of different companies, but also in different boxes belonging to the same company. The more common arrangement is to have an 'upper' and a 'lower' rope. These in some companies have a regulation length of 3 feet for the former and 1 foot 10 inches for the latter, while in others the length of rope to be allowed is left very much to the discretion of the porter. When adjusted, one end of each rope is attached to the right or left side of the head-stall below; the other end, belonging to the long rope, is carried upward to one side, and securely tied to an iron ring immediately beneath the roof above; while the still loose end of the short rope on the opposite side is in some cases attached low down to the partition in front, in others to a ring in the manger-board, and in a third to a ring in front of the manger.

"Another system is to run both ropes from the head-stall through a ring in the last-named position, and then fasten them to the front end of the box right and left of the horse's head. In some boxes only a single rope is employed, in which case one end is attached to the chin-strap of the head-stall and the other to a 6-lb. weight, which keeps the rope taut through a hole in the manger-board.

"It will be seen from this that, in all these methods of tethering, the ropes, in one form or another, are made to rest on or near the manger or manger-board, as the case may be, and consequently within reach of the horse's feet whenever he is disposed to place them there. It is no rare occurrence for excitable and refractory animals to land their fore-limbs in this position, even when the head is tied down within 6 inches of the manger-ring, and by entangling themselves in the ropes, to suffer severe, if not fatal, damage; indeed, this is the great source of mischief in connection with our horse traffic by rail.

"An ingenious and simple device for correcting this unsatisfactory state of things, and one in which I have taken a practical interest, has been designed by Mr. Bartrum, late veterinary officer to the Midland Railway Company, who have already recognized its merits and brought it into use. The appliance consists of a rope, one end of which is attached to a ring in front of the nose-band by means of a spring hook working on a swivel. The rope then passes upward, and over an adjustable pulley-wheel fixed in a slot in the partition between the stall and the coupé. Attached to

its other end is a small weight, surmounted by a spiral spring, and confined in a small box (fig. 653). By this arrangement only one rope is engaged in the tying, and that is entirely removed from possible contact with the feet. Instead of the horse being bound down by the head, he enjoys comparative freedom and comfort, and indeed such an amount of liberty as will enable him to recover himself from any awkward position in which he may, from restiveness or other cause, become involved. Another conspicuous and important advantage of the fastenings of this appliance is that, should he

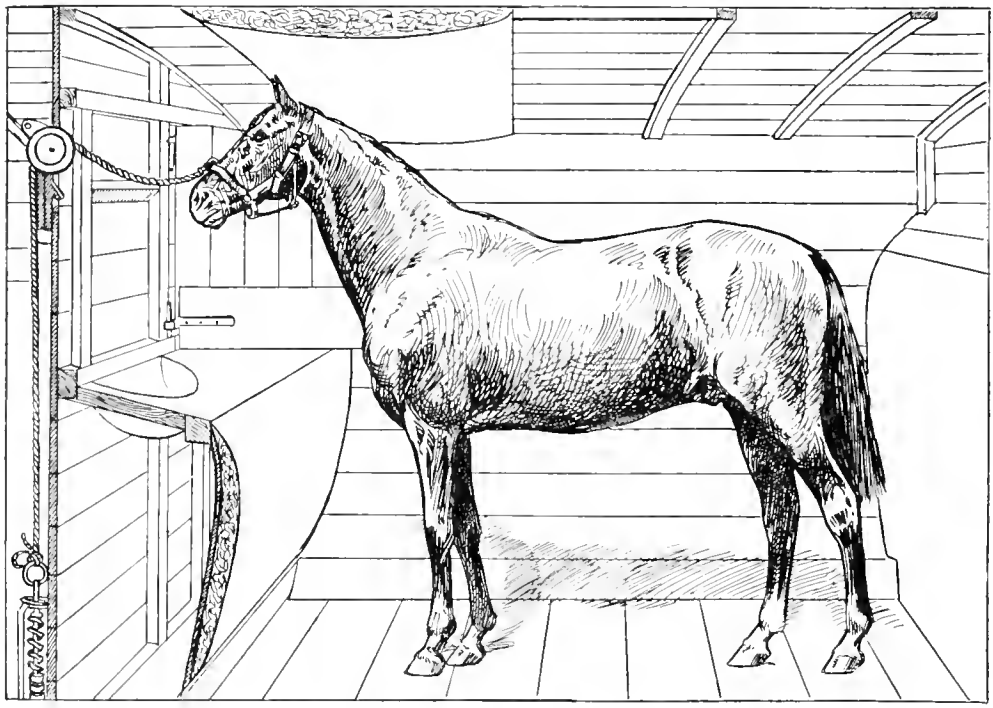


Fig. 653.—Bartrum's Tethering Apparatus

fail to free himself, he can be set at liberty at once, through the door of the coupé, by removing the spring hook from the ring in the nose-band. These and other solid advantages are presented by the Bartrum device, which promise to do away with much of that suffering and loss which attend the transit of horses by rail."

Another serious objection to horse-boxes is that the padding which prevents injury to the skin is not removable for purposes of disinfection or ordinary cleansing, hence the danger of infectious disease, even if the utmost care were exercised. The ordure from the last inmate commonly remains, despite Rule 15 (Transit Order, Animals Act), which requires that the vehicle shall be thoroughly cleansed according to specified directions therein contained. Neglect to comply with these orders carries

certain—or, rather, *un*certain—penalties, since the railway servants habitually disregard them.

Besides the horse-box there is the ordinary truck, which dealers, ever ready to accept additional risk in order to effect an economy, usually employ to convey their purchases on the often long journeys from fairs and markets. The truck is better cleansed and kept in a much more wholesome condition than the more expensive box, as for some reason the Animals Orders in connection with cattle are more respected, and these conveyances are frequently whitewashed and otherwise disinfected.

They hold some half-dozen horses, and the object of the consignor in packing them as closely as possible is to prevent them from kicking one another. In the use of the horse-box there is no rule as to having the hind shoes off, but it is a sort of *lex non scripta* of the truck, and usually insisted upon on board ship, but not on so-called horse "boats".

There is a special order issued by the Board of Agriculture with regard to watering horses on railway journeys by which the respective companies are made responsible, but owners have been prosecuted for not feeding animals on the journey while beyond their own control and detained on the road by some failure on the part of the carriers to deliver within reasonable time.

THE HORSE AND ITS POSITION IN THE ANIMAL WORLD

SECTION XIV.—THE HORSE AND ITS POSITION IN THE ANIMAL WORLD

THE HORSE OF THE PRESENT AND THE PAST

From the investigations of geologists we have learned the fact that the horse is descended from ancestors which existed in long-past ages of the world's history, and which were very different in many respects from the animal so familiar to us. Probably it will be very generally thought that it is late in the day to attempt to question, or even to defend, the teachings of geology, and the kindred subject of palæontology, or the science of extinct animal and vegetable life. At one period, however, not so remote as to be out of the recollection of many of the readers of to-day, the suggestion that the remains of animals and plants were to be found in certain "petrifactions", dug up from the depths of the earth, was met by opposition which was as violent as it was honest and ignorant.

Education has made rapid strides in all directions since the day of merely unreasoned opposition to the advance of science; and it may perhaps be said that the majority has changed its front, and is now either in favour of investigation and receptive to its results, or at least accepts them without any great effort, possibly it may be with some degree of indifference, but in any case no longer opposes them. On either assumption it will be no more than fair to the reader who may not be a scientist, and it will at the same time be inoffensive to the geologist and palæontologist, for whom the remarks are not intended, if we state in a few concise sentences the broad principles on which those experts base their arguments and conclusions.

In the first place it may be observed that it is now well known that rocks of different sorts constitute what is called the *crust* of the earth—that is, the superficial portion accessible to human observation—and what is more significant, that these rocks are not for the most part heaped together in disregard of order, but are arranged in a certain succession

of beds, or strata, from below upwards. The lowest rocks bear evident signs of the action of heat, and not being arranged in layers or strata, are distinguished as *unstratified* rocks, being also more or less *crystalline*. The higher rocks, above those more ancient igneous rocks, whether hard or soft, were originally deposited from water in the form of sediment, and hence are called *sedimentary* or aqueous rocks. These are *stratified*, and in them the remains of animals and plants are found more or less abundantly, such remains being absent from the igneous rocks. The name *fossils* is now familiar to everyone as applied to the remains of animals and plants found in rocks, and this term also includes markings, such as footprints and casts or impressions left on originally soft clay on which the object has rested or in which it has been enclosed.

To the discoveries of the geologist the naturalist applies the same mental processes which he uses in everyday life. He can see impressions which have been left on the sea-shore, footmarks of men and beasts on the sands, and, observing the marks, he realizes at once the existence of the different creatures that made them. A skull or a leg-bone dug up from a stone quarry or gravel-pit may attract his notice, and by the application of his knowledge of anatomy he can decide whether the part once belonged to a man or to an ox, a pig or a horse, and with added special knowledge he will go beyond this and define the formation from which it came, and form some idea of the period which has elapsed since it was deposited. In like manner the geologist sees how river banks and sea-walls are washed away year by year, and in other places how hollows are gradually filled by sedimentary deposits, which are left to harden into rocks, and by the exercise of his ordinary intelligence he comprehends how the strata in the earth's crust have been formed in succession by similarly slow and often-interrupted actions going on through long ages. It is of no avail to tell the palæontologist that the impressions of animals' feet, and the marks of shells and skeletons of birds and beasts and fishes, are not what they seem to him, but only "petrifactions", or "fossils", curious enough and highly interesting indeed, but in no way connected with living creatures of a former period, when all the while his senses of sight and touch inform him to the contrary. He can compare the fossil bone of many thousand years ago with the corresponding bones of the animals of to-day and mark the close relation between them. In fact, he is aware that often, in comparing the later fossil remains with specimens of similar parts of recent origin which have been buried close to the latest fossils, he finds a difficulty in distinguishing between them. In short, the scientist observes and reasons exactly as other people do. Of his facts he is as sure as any enquirer into everyday common things can be of his, and like

him he exercises his intellect and imagination in drawing conclusions from the facts which come under his observation.

It is true that some difference may exist between the mental processes of the expert and those of the unscientific observer, but it is only one of degree. The scientist is a trained, and therefore a keen investigator, and his imagination is active as well as critical. Small matters which an ordinary looker-on may pass by, the expert seizes and does not allow to escape until he has exhausted their teaching. The method of Zadig is the one which he, perhaps unconsciously, adopts in all his enquiries. What that method is most people know, but as it may have been known and forgotten, it may be well to follow Huxley's example in his lectures on evolution and quote the short story of the sage entire.

According to Voltaire, Zadig, whose country, indeed whose existence, is problematical, dwelt on the banks of the Euphrates, and occupied his lonely life in the close study of nature. Thus by degrees he acquired a marvellously keen power of observation and profound sagacity, of which the following example may be given:—

"One day walking near a wood," so the story is told, "he saw hastening that way one of the queen's chief eunuchs, followed by a troop of officials, who appeared to be in the greatest anxiety, running hither and thither, like men distraught, in search of some lost treasure.

"'Young man,' cried the eunuch, 'have you seen the queen's dog?' Zadig answered modestly, 'A bitch, I think, not a dog.' 'Quite right,' replied the eunuch; and Zadig continued, 'A very small spaniel, who has lately had puppies; she limps with the left foreleg, and has very long ears.' 'Ah! you have seen her, then,' said the breathless eunuch. 'No,' answered Zadig, 'I have not seen her; and I really was not aware that the queen possessed a spaniel.'

"By an odd coincidence, at the very same time the handsomest horse in the king's stables broke away from his groom in the Babylonian plains. The grand huntsman and all his staff were seeking the horse with as much anxiety as the eunuch and his people the spaniel; and the grand huntsman asked Zadig if he had not seen the king's horse go that way.

"'A first-rate galloper, small-hoofed, 5 feet high, tail $3\frac{1}{2}$ feet long; cheek-pieces of the bit of twenty-three-carat gold; shoes silver?' said Zadig.

"'Which way did he go? Where is he?' cried the grand huntsman.

"'I have not seen anything of the horse, and I never heard of him before,' replied Zadig.

"The grand huntsman and the chief eunuch made sure that Zadig had stolen both the king's horse and the queen's spaniel, so they haled him

before the High Court of *Desterham*, which at once condemned him to the knout and transportation for life to Siberia. But the sentence was hardly pronounced when the lost horse and spaniel were found. So the judges were under the painful necessity of reconsidering their decision, but they fined Zadig four hundred ounces of gold for saying he had seen that which he had not seen.

"The first thing was to pay the fine; afterwards Zadig was permitted to open his defence to the court, which he did in the following terms:—

"'Stars of justice, abysses of knowledge, mirrors of truth whose gravity is as that of lead, whose inflexibility is as that of iron, who rival the diamond in clearness, and possess no little affinity with gold; since I am permitted to address your august assembly, I swear by Ormuzd that I have never seen the respectable lady dog of the queen, nor beheld the sacrosanct horse of the king of kings.

"'This is what happened. I was taking a walk towards the little wood near which I subsequently had the honour to meet the venerable chief eunuch and the most illustrious grand huntsman. I noticed the track of an animal in the sand, and it was easy to see that it was that of a small dog. Long faint streaks upon the little elevations of sand between the footmarks convinced me that it was a she dog with pendent dugs, showing that she must have had puppies not many days since. Other scrapings of the sand which always lay close to the marks of the fore-paws indicated that she had very long ears; and as the imprint of one foot was always fainter than those of the other three, I judged that the lady dog of our august queen was, if I may venture to say so, a little lame.

"'With respect to the horse of the king of kings, permit me to observe that, wandering through the paths which traverse the wood I noticed the marks of horse-shoes. They were all equidistant. "Ah!" said I, "this is a famous galloper." In a narrow valley only 7 feet wide the dust upon the trunks of the trees was a little disturbed at $3\frac{1}{2}$ feet from the middle of the path. "This horse," said I to myself, "had a tail $3\frac{1}{2}$ feet long, and lashing it from one side to the other he has swept away the dust." Branches of the trees met overhead at the height of 5 feet, and under them I saw newly-fallen leaves; so I knew that the horse had brushed some of the branches and was therefore 5 feet high. As to his bit, it must have been made of twenty-three-carat gold, for he had rubbed it against a stone which had turned out to be a touchstone; with the properties of which I am familiar by experiment. Lastly, by the marks which his shoes left upon pebbles of another kind I was led to think that his shoes were of fine silver.'

"All the judges admired Zadig's profound and subtle discernment;

and the fame of it reached even the king and the queen. From the anteroom to the presence-chamber Zadig's name was in everybody's mouth; and although many of the magi were of opinion that he ought to be burnt as a sorcerer, the king commanded that the four hundred ounces of gold which he had been fined should be restored to him. So the officers of the court went in state with the four hundred ounces; only they retained three hundred and ninety-eight for legal expenses, and their servants expected fees."

That the method of Zadig is the method which is pursued by all reasoning men must be evident from this illustration. In Zadig's case the method was exhibited in a condition of the highest refinement, and since his time, and possibly before it, has been practised by many, the untutored savage among them, who never heard the philosopher's name. In considering the facts and arguments on the development of the horse, which is the subject of the following pages, the reader is invited to bring Zadig's method to bear, and that he may begin with a clear understanding of the object which will be kept in view throughout it is stated in plain terms in the following proposition.

The horse of the present time may be traced, through a long line of fossil remains of ancestral forms, back to the first discovered hoofed mammals in the earliest beds (Eocene) of the Tertiary formation.[1]

The relation between the fossil remains and the present living animal is the more easily shown in the case of the horse, and its immediate relatives the varieties of the ass, zebra, and quagga, as these are all marked by special characters, most of which can be very readily recognized in the fossil specimens of the progenitors of the race which have been brought to light in the course of geological explorations.

Before noticing the particular features of the equine group, it will be necessary to define the position which its members occupy in nature.

The whole of the Equidæ or horse family belong to the Vertebrate kingdom and to the class Mammalia, which is separated by old writers into two great orders or divisions, the *Ungulata* or hoofed mammals, and the *Unguiculata*, including all animals with claws. This classification originated with John Ray in his *Synopsis Methodica Animaliam*, published in 1693. Sir William Flower in his work on the horse remarks on the artificial character of the mode of division, but adds that some portion of the system has survived, especially the group Ungulata, which has been resuscitated of late years and used as a convenient designation for the group of quadrupeds that are distinctively hoofed.

[1] The Tertiary is the third of the great life-periods known to geologists, being followed by the Post-tertiary or Quaternary, to which present-day life belongs.

Ungulate mammals are described by Sir W. Flower as animals which are eminently qualified for a life on land, and in the main for a vegetable diet. Their molar teeth have broad crowns with tuberculated or ridged grinding surfaces, and they have a perfect set of milk teeth, which are changed for permanent ones as the animals advance towards maturity. A very important point in their anatomy is the absence of collar-bones (clavicles). Their toes are covered with horny material, which usually encloses them completely, forming broad blunt nails or hoofs.

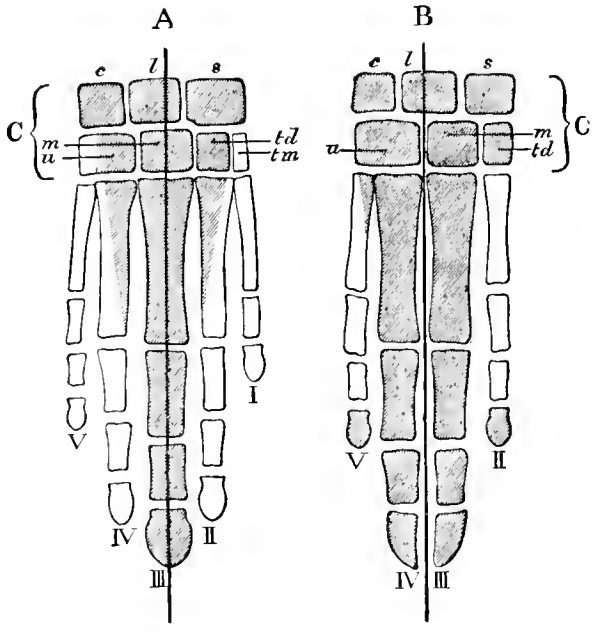


Fig. 654.—A, Diagram representing the Bones of the Right Fore-foot of an Odd-toed or Perissodactyle Animal. B, Diagram of the Bones of the Foot of an Even-toed Artiodactyle Animal. c, The Carpus or Wrist (knee of quadruped), consisting of two rows of bones

The upper row consists of *c*, cuneiform; *l*, lunar; and *s*, scaphoid; the lower row *u*, unciform; *m*, magnum; and *td*, trapezoid; with the trapezium, *tm*, behind the cuneiform. The shaded parts of the bones in A are those that are now present in the horse: in B, those that are present in the ox. In five-toed mammals the digits are numbered one to five, beginning from the inner side of the limb. Digit No. I in the upper or fore extremity is the thumb (*pollex*), and in the hind or lower extremity the great toe (*hallux*); the other digits are distinguished by the figures II, III, IV, and V.

Cuvier, and after him Owen, distinguished two well-marked groups of ungulates, the fossil remains of which are found throughout the Tertiary period, the *Artiodactyla* or even-toed, and the *Perissodactyla* or odd-toed animals, both still represented by living forms.

To realize the significance of these divisions it must be borne in mind that the number of toes in mammals is limited to five on each extremity. Each toe is the end of a series of bones starting from a compound joint, the *carpus* or wrist in the front or upper extremity (arm or fore-leg), and the *tarsus* or heel in the hind or lower extremity. To the series of bones the name *digits* is applied to express either fingers or toes, and the term *phalanges* is used to indicate the separate bones of which the digits are composed.

The annexed diagram, with the description taken from Professor Sir W. Flower's work, will make the above remarks intelligible.

So far all is quite simple; but it happens in nature, and it may also occur by chance, that one or more of the digits may be missing. Still the biologist is expected to decide from those which remain whether the

animal belonged to the odd-toed or even-toed group, and it will shortly appear that it is most essential that there should be no risk of error in the conclusion arrived at.

It will be seen by referring to fig. 654 that there is a marked difference in the arrangement of the digits in the two figures in the diagram. In the first figure, A, which may be taken to represent the foot of an early ancestor of the horse, the five digits are shown. The shaded parts are the bones which are to be found in the horse now existing. The special feature of the *perissodactyle* or odd-toed animal is the one large middle digit, the third in situation. In the next figure, B, representing the foot of the ox, the plan of construction is that of the *artiodactyle* or even-toed group. The first digit is not present, even in the most ancient members of the group, the second and fifth are absent or rudimentary in the recent members, and instead of one large middle digit there are two of equal size. These are distinct, and form the so-called cloven hoof of the ox, which is, in fact, constituted of the two middle digits, the third and fourth in situation. The shaded parts of the bones in the second and fifth digits in the diagram show the portions which remain in the foot of the ox.

Even a tyro in the science of anatomy will be able to understand the value of the indications afforded by the middle digit or digits in assigning to the animal to which they belong its proper position in the order Ungulata. For further illustration it may be assumed that the bones of the foot of an imaginary animal are in question, and it is granted that the animal is an ungulate mammal, and must therefore belong to the odd-toed or even-toed group. To determine which, the enquirer proceeds to examine the bones of the extremities below the carpus or wrist, otherwise called the *knee*, and the tarsus or heel, known as the *hock* in quadrupeds. Finding below these joints one large digit, no matter what other bones are present or absent, it is at once decided that the animal is one of the *perissodactyle* or odd-toed mammals. If, however, there are two equal digits, it is as certain that the animal is one of the *artiodactyle* or even-toed mammals.

Applying this scheme to the horse, it will be evident that as there is "one big digit", consisting of four phalanges extending from the knee or hock to the toe, on the hoof-covered tip of which the horse stands, the animal must be classed with the perissodactyles or odd-toed, and also with the *Solidungula* or single-hoofed mammals.

Attached to the back of the one big digit of the horse, the leg-bone, *cannon* or *shank bone* as it is sometimes called, are the well-known *splint*-bones, one on each side, reaching from the knee or hock to a point

about two-thirds of the length of the first of the phalanges. It can hardly be doubted that these splint-bones are the vestiges or representatives of the second and fourth digits seen in the remote ancestors of our horses. What has become of the first and fifth digits is a question to which no convincing answer has yet been given. Certain horny excrescences, termed *corns* or *chestnuts*, situated on the inner side of the legs above the knees and at the lower part of the hocks, and also the horny growths found at the back of the fetlock joints, partly or entirely concealed by the long hair which is usually abundant in that part, have been looked upon as the rudiments of the missing digits; but there are some facts connected with their situation in the limbs which do not support this view. Whatever may be their true place in the animal economy, these horny growths have always attracted attention, and much speculation has been indulged in as to their meaning. At the least it may be said of them that they serve to identify the members of the equine family, and to some extent aid in separating the various members of the group one from the other. In their typical form the chestnuts on the hind and fore extremities are characteristic of *Equus caballus*—the scientific name of the horse. Asses and zebras have them in a much-modified form on the fore limbs only. The excrescences (ergots) at the back of the fetlock are as in the horse.

The anatomical characters of the growths will be described more particularly in connection with some other specialities of the horse when the general structure of the animal is considered.

At this point it will be convenient to pause for a moment to note the general character of the evidence which has been produced.

The preceding remarks have enabled us to ascertain with some exactness the place of the horse in nature, and we have further noted some of the more prominent special characters of the Equidæ in their relations to the fossil remains of extinct animals in which those special features had a more perfectly-developed form, suggesting that in those animals they formed an actively useful and essential part of their organization.

At this early stage of the investigation it is not intended to suggest that the evidence which has already been advanced is in itself sufficient to prove that the horse is a descendant of some remote ungulate mammal which had five perfect digits instead of the "one big digit" by which it is now distinguished. On the contrary, many more facts have to be brought forward and carefully analysed before that proposition can be considered as proved.

Huxley, in his lectures on evolution, delivered in New York in 1876, observes that the occurrence of historical facts is said to be demonstrated when the evidence is of such a character as to render the assumption that

they did not happen improbable in the highest degree. It is requisite, therefore, to consider the evidence bearing on the evolution of the horse, and it will render the subject all the more easy of comprehension if an attempt be made to explain what the word evolution is intended to express.

At the outset it may be remarked that the doctrine of evolution is not exactly new. "The great theory of evolution", writes Mr. Hutchinson in *The Creatures of Other Days*, "was first dimly suggested by Greek philosophers, such as Anaximander (B.C. 610), who may have derived the idea from Egyptian, Babylonian, or Hindu sources; then revived in a more scientific form by Lamarck last century. In recent years it has been placed on a truly scientific basis by the illustrious Charles Darwin, and is now generally accepted by naturalists. Indeed it is hard in these days to escape being an *evolutionist*, so abundant is the evidence in favour of the doctrine, especially that derived from a study of extinct animals."

Huxley writes in reference to *evolution* as the acting force in the past history of Nature, "that at any comparatively late period of past time, an imaginary spectator would have met with a state of things very similar to that which now obtains; but that the likeness of the past to the present would gradually become less and less, in proportion to the remoteness of his period of observation from the present day. Preceding the forms of life which now exist, the observer would see animals and plants not identical with them but like them, their differences increasing with their antiquity, and at the same time becoming simpler and simpler; until finally the world of life would present nothing but that *undifferentiated protoplasmic* matter, which, so far as our present knowledge goes, is the common foundation of all vital activity!" To all of which the reader, according to his views, may urge the series of objections which have from the first been formulated and overruled. How is it possible, it may be asked, that a mass of protoplasmic matter—a simple, jelly-like mass, giving hardly any evidence of life—can, under the influence of *varying conditions of environment*, become resolved into plants and animals, advancing steadily from the lowest forms to the highest? Clearly, the answer comes; the possibility cannot be disputed, the changes are going on perpetually under our eyes. Take the seed of a plant, or, better still, the ovum of an animal, and place it under favourable conditions, and the process of evolution begins and goes on to its completion. Structures are successively evolved without any interference from without, until a miniature man, or a lower animal, or a plant is formed. It is very interesting to observe that in the process of development, as Von Baer found, every organism in its earliest stages has the greatest number of characters in common with all other organisms in their earliest stages,

and at a stage somewhat later, its structure is like the structures displayed at corresponding phases by a less extensive multitude of organisms. At each subsequent stage features are acquired which successively distinguish the embryo from groups of embryos which it previously resembled, thus step by step diminishing the class of embryos which it still resembles, and finally the class is narrowed to the species of which it is a member. The embryo of a bird or a rabbit has at one time in its development characters resembling those of the embryo of the fish—structures representing gill-clefts, for example. In the human embryo, it is only after exhibiting successive changes characteristic of the organization of lower animals that it at last assumes the form proper to man.

To the naturalist many instances will readily occur of remarkable changes of form during the evolution of an animal from the ovum to the mature stage. Steenstrupp, the Danish naturalist, in 1845 summarized the process of development in the Medusæ, Entozoa, and others of the lower animals, under the title of "Alternation of Generations", which he described as "the remarkable and till now inexplicable natural phenomenon of an animal producing an offspring, which at no time resembles its parent; but which, on the other hand, itself brings forth a progeny which returns in its form and nature to the parent animal: so that the maternal animal does not meet with its resemblance in its own brood, but in its descendants of the second, third, or fourth generation." This remarkable form of evolution is exhibited in the reproductive process of the parasite the liver fluke (*Distoma hepaticum*) in the most striking manner. The parent fluke provides the ovum, and there its responsibility seems to cease. Hatching takes place in any moist spot or stagnant pool. The product, however, is not a young fluke, but a *long, thin embryo*, having no resemblance to the parent. Soon, however, this undergoes a change into a cyst, or sort of bag, in the interior of which are developed more advanced organisms known as *redia*, and in them, again, still more advanced tailed *cercaria* appear, which are nearest to the form of the fluke, and only await entrance into the body of a warm-blooded animal to acquire their perfect form and thus prove their descent from their original parent. (See p. 260 of this volume.)

Equally remarkable transformations occur during the development of the embryo in the higher animals, but these go on within the organism of the parent, or otherwise while the young animal is enclosed in the shell of the egg. It is, however, possible to imagine that the *changes* which occur in the embryo, which is hidden from sight, as in the egg of the bird or the uterus of the mammalian, might be displayed to view, as it is in some of the *Entozoa* and other animals lower in the scale of life. What a wonderful

series of phenomena would be exhibited! Instead of sitting on her eggs for weeks, the common hen would find her brood at the expiration of a few days hatched but palpably unfinished, very unlike the chickens to which she had been accustomed. The young living beings would present some of the characteristics of the mammal, but they would also, in certain parts of their organism, show structures connecting them with reptiles, and, in the arrangement of the *blood-vessels*, they would run the risk of being classed among fishes.

Day by day almost imperceptible changes would be distinguished by the critical observer, and gradually the unnamed living thing would assert its claim to be accepted as a bird, and finally the expert would decide, without the least chance of making a blunder, to which particular species, genus, and variety of birds the mysterious creature belonged. In like manner it might be supposed, for the sake of illustration, that the mare, instead of producing a foal at the end of several months, would give birth at an earlier period to an unfinished organism in which some of the characteristics of the lower Vertebrata would be recognized, those of the reptile or the fish, for example. Gradually advancing day by day, the young organism would exhibit in turn, in the circulatory system especially, some of the features belonging to the bird, and passing through the changes which mark certain phases in the organization of the lower mammals, it would arrive at the stage of perfect development and assume the form of the parent.

In reply to the very easy and obvious criticism that the above description is absurd, and that the processes referred to could not possibly take place, it may be observed that nothing has been advanced of a hypothetical character. All the changes or metamorphoses referred to do constantly occur, and the only liberty which has been taken has been that of supposing them to be visible. Facts which are invisible to the ordinary observer, but perfectly distinct to the skilled microscopist, have been assumed to occur in such a position that they might be recognized by the unaided eye. The facts are not the less real because they do not present themselves in a palpable form. In the study of embryology all these changes are recognized, but they are visible only by the aid of the microscope. If they formed part of the ordinary observation of the breeder of stock, as they do of the investigations of the scientist, the mysterious doctrine of evolution would lose its glamour, and become one phase of mere commonplace experience.

Replying to some of the objections which have been urged against the doctrine of evolution, the late Herbert Spencer deals with two forms of criticism which have often been advanced, one relating to the obvious and admitted fact that the process of evolving a new species has never been

seen, and the other to the difficulty which is based on the ground of the extent of time which would necessarily be required for the development of highly-organized living creatures out of a *mass of jelly-like protoplasm*.

On the first point he quotes from the late Lord Salisbury's address to the British Association, in which the speaker says that no man or succession of men have ever observed the whole process in any single case, and certainly no man has recorded the observation. In reply, Herbert Spencer quotes from an essay which was published many years ago in pre-Darwinian days, in which the author remarks: "In a debate upon the development hypothesis lately narrated to me by a friend, one of the disputants was described as arguing that as, in all our experience, we know of no such phenomenon as transmutation of species, it is unphilosophical to assume that transmutation of species ever takes place. Had I been present, I think that, passing over his assertion, which is open to criticism, I should have replied that, as in all our experience we had never known a species *created*, it was by his own showing unphilosophical to assume that any species ever had been created."

Thus, supposing the two hypotheses—special creation and evolution by natural selection—are to be tested by the directly-observed facts assigned in their support, then, if the hypothesis of evolution by natural selection is to be rejected because there are no directly-observed facts which prove it, the hypothesis of special creation must be rejected for the same reason. In fact, it would be impossible to arrive at any conclusion by such a line of argument.

On the subject of the time which would be required for the evolution of a living being of advanced type, the difficulty is thus cogently propounded. "If we think of the vast distance over which Darwin conducts us, from the jelly-fish lying on the primæval beach to man as we know him now, if we reflect that the prodigious changes requisite to transform one into the other are made up of a chain of generations each advancing by a minute variation from the form of its predecessor, and if we further reflect that these successive changes are so minute that, in the course of our historical period—say three thousand years—this progressive variation has not advanced by a single step perceptible to our eyes, in respect to man or the animals or plants with which man is familiar, we shall admit that for a change so vast, of which the smallest link is longer than our recorded history, the biologists are making no extravagant claim when they demand at least many hundred millions of years for the accomplishment of the stupendous process." In reply to this Herbert Spencer, setting aside the statement that the jelly-fish is a remote ancestor of man, quotes again from a portion of the essay previously referred to where the writer, after admitting that those who

know nothing of the science of life may naturally think the hypothesis that all races of beings, man inclusive, may in process of time have been evolved from the simplest monad a "ludicrous one", continues: "But for the physiologist who knows that every individual being is so evolved, who knows further that in their earliest condition the germs of all plants and animals whatever are so similar that there is no appreciable distinction among them which would enable it to be determined whether any particular molecule is the germ of a Conferva or of an Oak, of a Zoophyte or of a 'Man'—for him to make a difficulty of the matter is inexcusable. Surely if a single cell, when subjected to certain influences, becomes a man in the space of twenty years, there is nothing absurd in the hypothesis that under certain other influences a cell may in the course of millions of years give origin to the human race."

In regard to the time required for the alleged evolutionary changes, he accepts Lord Kelvin's proposition to the effect that, "life cannot have existed on the earth for more than a hundred million years". At the same time it is pointed out that the proposition is open to doubt. Other geologists, quoted by Huxley in his lectures on evolution, assert that five hundred million years were occupied in the completion of the Tertiary formations, and in that case the period may be taken as the measure of the duration of the evolution of the horse; but the lecturer goes on to suggest that he is not much concerned about the discrepancies in calculations as to time, the chief point of enquiry being "is it a fact that evolution took place?" That question being answered, the time required for the process may be left to be determined by the physicist and the astronomer.

Herbert Spencer, however, waiving all criticism, accepts the lower estimate of one hundred million years as the time required, and proceeds to compare the changes in the development of the embryo with the evolutionary changes, as exhibited in the Tertiary formation, in regard to their extent and the time occupied by them.

"The nine months of human gestation, more exactly stated, is 280 days, that is 6720 hours or 403,200 minutes. Thus, then, the total change from the nucleated cell constituting the human ovum to the developed structures of the infant just born, is divisible into 403,200 changes each occupying a minute. No one of these changes is appreciable by the eye or even by a micrometer." Turning to the other member of the comparison, the writer proceeds to contrast the evolution of a man from a primitive *protozoon* with the evolution of the infant from the protoplasm in the cell of the human ovum. In doing this he supposes the developmental changes from the jelly-fish to the man to be equal in their number to those gone through by the fœtus. And in order to arrive at a result he divides 100,000,000 years

by 403,200 changes, a simple sum which gives in its quotient a period of nearly 250 years as the interval available for an amount of change equal to that which the fœtus undergoes in a minute. If, instead of the human ovum, the ovum of a rabbit had been taken for comparison, the contrast in point of time would have been of necessity more striking, as similar changes to those which occur in the human ovum during nine months take place in that of the rabbit in a few weeks.

It will be observed that the argument is not directed to the proof that man was evolved from a jelly-fish or other primitive protozoon, but rather to the fact of there having been according to the lowest estimate ample time for the process, seeing that in the ordinary course of things a child is evolved from a mass of protoplasm in a few months, and advances to the condition of a man in the course of some twenty years.

Enough has been said to leave no room for reasonable doubt that whatever may be its limitation, evolution is a natural process, the successive steps of which may be observed and recognized, as in the examples which have been given.

It is, of course, open to anyone to oppose the proposition that every existing organism, animal and plant, was developed from some original and undifferentiated protoplasmic matter, just as the fœtus is developed from a microscopic speck of protoplasm. Nor is it required for the present purpose that the proposition should be accepted. It cannot be denied, on the other hand, that under the influence of changes in the environment certain important alterations of form and function do happen, and are indicated by the presence among existing beings of organs and parts which are so placed as to be devoid of any functional value, while a comparison of them with similar and more developed parts in extinct races necessarily leads to the presumption that they may be, and most probably are, rudimentary or vestigial remains modified by the laws of heredity and the influence of natural and artificial selection.

Leaving now the general for the particular, the question which presents itself relates to the facts which are offered by the anatomist and the palæontologist, in regard to structure and conformation, bearing upon the statement that the horse may be traced through a long line of extinct mammals back to the earliest mammals of the Tertiary period.

SPECIAL FEATURES IN STRUCTURE

The horse is generally described as a remarkable animal, at once exhibiting perfection of mechanism, complete balance of form, as well as beauty of outline. Professor Sir W. Flower lays great stress on the

specialization of the horse, that is, the modification of its structure from the average type of quadruped to meet some special requirements. The horse is a favourite subject for the evolutionist, as illustrating probably more satisfactorily than any other mammal the truth of the doctrine of evolution. In particular, various rudimentary and apparently useless parts are met with in the horse which correspond to fully-developed structures found in other mammals. Such rudimentary structures in animals may either be in process of growth or they may have the character of *restigial remains*; that is, they may be structures that have degenerated from a former more perfect state of development and are now only vestiges of what they once were. In the horse most of the rudimentary structures and parts appear to be in the *restigial condition*, and the discoveries in the geological history of the horse all point to that conclusion.

Although the horse as it now exists may be looked upon as one of the most recent among animals from the point of view of the geologist and naturalist, from the historian's point of view its antiquity is considerable, since it can be traced back almost to the beginning of the historic period. According to Dr. George Fleming, the horse was domesticated among the Egyptians nearly 2000 years B.C. The Persians, Greeks, and Romans used the horse for ordinary work and in war not only to carry the riders, but also for the even more useful purpose of being harnessed to chariots, with which the armed warriors were accustomed to attack. (See the chapters on the History of the Horse.) That the horse is specially adapted for the purpose of supporting weight and also for rapid movement, we might conclude even from an inspection of the skeleton, which with all its delicacy of outline is so adjusted, that great strength is combined with perfect elasticity.

Bony Framework.—The accompanying illustration (fig. 655) will show that in many respects it is possible to compare the bony framework of the horse with that of man, in whose structure the highest type of anatomical mechanism is exhibited.

For the general reader the most interesting feature in the illustration will be the arrangement of the joints of the limbs of the horse in comparison with those of man, and a very little study of the engraving will correct some popular errors, such, for instance, as refer to the position of the knee of the horse. The real knee of the animal is, in the phraseology of the horseman, the *stifle-joint*, and the joint which is usually called the knee of the horse is in reality the wrist. The letters in the illustration indicate the true shoulder, elbow, wrist, hip, knee, and ankle in both man and horse.

Commencing with the fore parts of the skeleton, we will first notice the

joint which is called the wrist or *carpus*, the knee of the horse as it is wrongly named. In this two rows of small bones are arranged, as can be seen in the figure, between the arm-bone above and the shank-bones below, the latter consisting of one large bone and two small splint-bones attached to it. In man the corresponding arrangement conduces to a very important end—a series of movements in the hand and arm which are

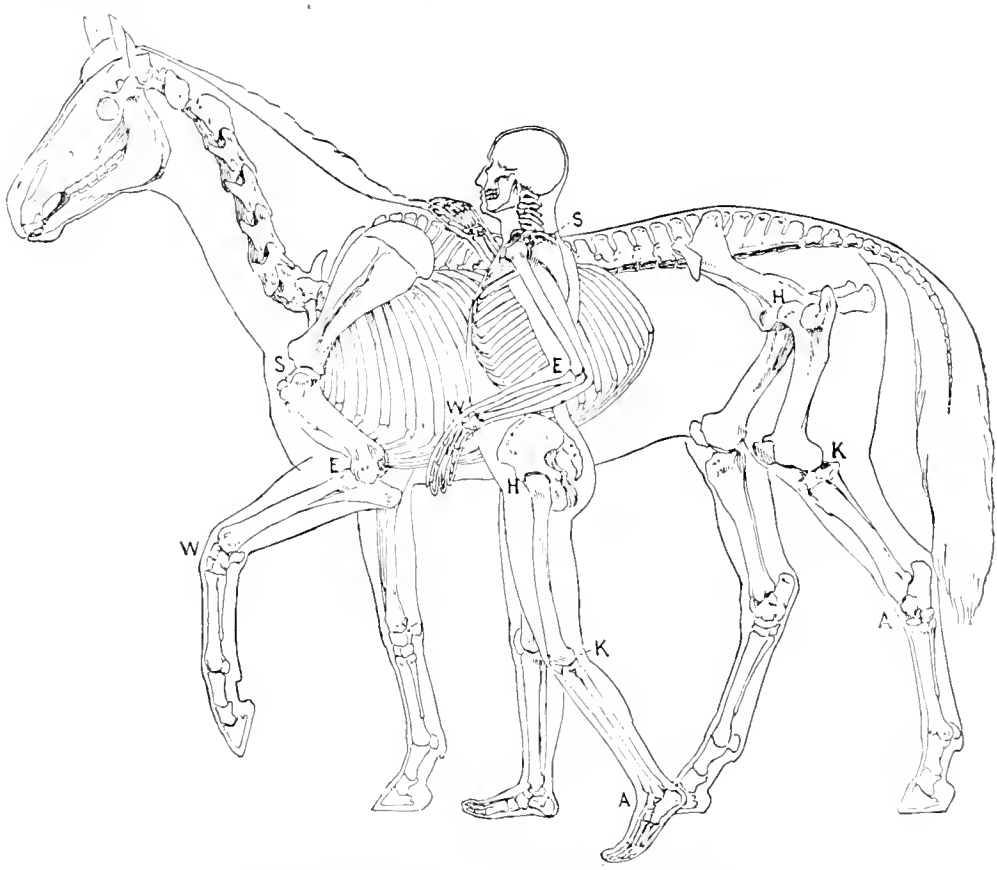


Fig. 655.—Comparative View of Skeletons of Man and Horse

S, Shoulder-joint; E, elbow-joint; W, wrist-joint (so-called knee in the horse); H, hip-joint; K, knee (stifle-joint in the horse); A, ankle (hock-joint in the horse).

mechanically impossible in the horse, notwithstanding the apparent similarity of structure.

The hand of man constantly performs the movements of flexion and extension, as they are called (these being hinge-like motions with extensive lateral movement), and in addition almost perfect rotation, at least to the extent of two-thirds of the circle. On the other hand, the horse's wrist or knee is only capable of flexion and extension.

Nearly the same degree and exactly the same variety of movement are

possible in the elbow-joint of man, while in the horse, owing to the rudimentary form of the second bone of the arm (*the ulna*), no lateral or rotatory motion can take place. The movement is purely hinge-like.

Another marked peculiarity is observed in the connection of the shoulder-blade (*scapula*) with the trunk. In man the junction is effected by a bone known as the collar-bone (or *clavicle*), which extends from the shoulder-bone near the shoulder-joint to the first rib on each side. The horse has no vestige of a collar-bone; the shoulder-blade (*scapula*) is joined to the trunk only by means of the muscles which are attached to it, so that the *fore* part of the horse's body is suspended by the aid of muscular bands between the two fore-legs.

An examination of the hinder limbs will show that the general plan of construction is nearly the same in both man and horse, as far as the joints are concerned. The hip-joint, the stifle (the true knee) with the floating bone or knee-cap (*patella*), and the hock (ankle of man) are almost identical in mechanical arrangement.

With regard to the hock-joint it may be observed that the two rows of small bones are placed as in the ankle of man, but the movement of the joint is purely hinge-like, and experience proves that the two rows of small bones may be cemented together, and to the cannon-bones and splint-bones below them, by bony deposits in old horses without causing any defect in the action—to a sufficient extent, at least, to be noticed. In fact, the provision for perfectly complete flexion in the hock-joint is secured by the mode of junction of the bones called *tibia* and *astragalus* (see fig. 658). The so-called *cushion* bones do not appear to contribute much, if anything, to the mobility of the joint, in the flexion and extension of which the small bones are largely concerned.

Below the knee in front, and the hock behind, begins the hand and foot respectively. The one large digit in each extremity, composed of what are called the *metacarpal* and *metatarsal* bones; the rudimentary second and fourth digits (the splint-bones) attached to them, and reaching two-thirds of their length, and the three following phalanges, constitute the true hand and foot. The horse, in fact, stands on those parts which in man form respectively the tip of the middle finger and the point of the middle toe, both of which are capped with an investing hoof instead of a nail.

The next illustration shows the exact relation between the finger of man and the reputed foot of the horse. How very close the anatomical relation is will be at once evident.

The chief anatomical difference between the fingers of man and the foot of the horse (which represents the end of the middle finger) consists in the presence of—(1) a complete horny box or hoof, which covers the organ in

the horse; (2) the three floating bones or sesamoids, of which two are attached to the back of the lower end of the metacarpal bone and one navicular behind the last phalanx, or rather between it and the articular end of the bone immediately above it, the coronal bone or short pastern.

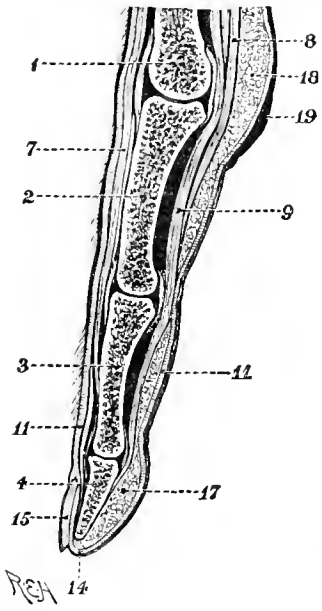


Fig. 656.—Section of Finger of Man

1. Metacarpal bone.
2. First phalanx.
3. Second phalanx.
4. Third or ungual phalanx (pedal bone of horse).
(5–6 wanting).
7. Tendon of extensor muscles.
8. Tendon of superficial flexor (flexor perforatus).
9. Tendon of deep flexor (flexor perforans).
11 and 14. Derma or true skin.
15. Nail (imperfect hoof of horse).
17. Fibro-fatty cushion of end of finger.
18. Fibro-fatty cushion of palm behind metacarpal phalangeal joint.
19. Thickened epidermal covering of the same.

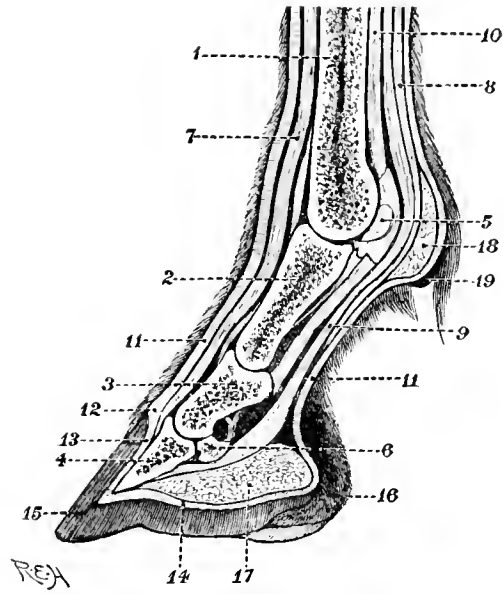


Fig. 657.—Section of Foot of Horse

1. Metacarpal bone.
2. First phalanx.
3. Second phalanx.
4. Third or ungual phalanx.
5. One of the upper sesamoid bones.
6. Lower sesamoid or navicular bone.
7. Tendon of extensor muscle.
8. Tendon of superficial flexor (flexor perforatus).
9. Tendon of deep flexor (flexor perforans).
10. Short flexor or suspensory ligament of the fetlock.
11. Derma or true skin continued into
12. Coronary cushion.
13, 14. Villous portion of the hoof matrix.
15. Hoof.
16. The heel.
17. Plantar cushion.
18. Fibro-fatty cushion of the fetlock.
19. Horny excrescence or spur (ergot).

In the human hand two sesamoid bones are found where the thumb articulates with the first metacarpal bone on the inner or palm surface. None exists elsewhere in the hand.

When we give full weight to the points of difference in the fore-limbs of the horse, as compared with the upper (fore) extremity of man, the similarity in the details of the plan of construction in both man and horse must seem far more striking than the variations, and this fact, taken in

connection with the marked difference in the position and general functions of the fore extremities in each subject, is certainly more suggestive of evolution than of special design. Unless on the theory of evolution from remote ancestors, it is indeed *unintelligible* that all the bones of the carpus (wrist) of man, conducing as they do to the greatest perfection of complicated movements, should be represented in the same joint (knee) of the horse, but so modified in their arrangement as to permit of no more than a simple hinge-like motion, which is quite effectually provided for in other hinge-joints by the adaptation of two bones only. And again, *some of the digits*

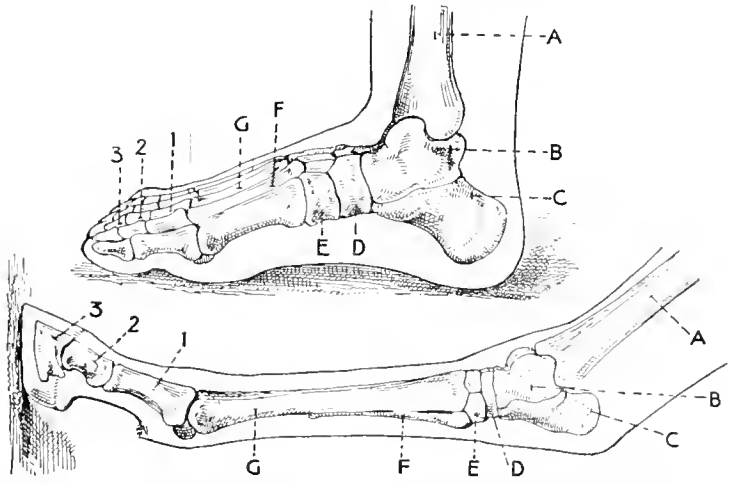


Fig. 658.—Foot of Man and Foot of Horse Compared in Natural Positions
(Note position of ground surface in each case.)

A, Tibia. B, Astragalus. C, Calcis. D, Scaphoid. E, Internal cuneiform. F, Splint-bone (a vestige of 2nd metatarsal). G, Cannon bone, or 3rd metatarsal. 1, 2, 3, Phalanges.

of man, one of the five-fingered and five-toed mammals, are represented in the horse by undeveloped structures or rudiments which serve no useful purpose, as the horse walks on the tip of a single finger and a single toe; in the foot of man, on the contrary, the whole of the bones from the ankle-joint are brought into use, forming the plantar surface or sole. Such a modification of structure in the lower animal can be understood only on the assumption that it was the result of a gradual process of development through which the five-toed foot of the horse's remote ancestors was in course of ages transformed to the one-toed foot of the horse as we now know it. A very pronounced series of changes it must be allowed, the true character of which will be more easily understood by reference to figs. 658 and 659, taken by permission of the Royal Agricultural Society from an article on the structure of the horse's foot by Professor Sir Geo. T. Brown, and published in the Society's Journal, 1891.

In fig. 658 both man and horse have the foot placed as it is in nature.

Man presents the entire under surfaces of the bones of the tarsus (hock of the horse), with the metatarsal bones and the four phalanges, to the ground surface, while the horse stands on the fourth or terminal phalanx. Fig. 659 shows the positions reversed; the foot of the man has the points of the toes on the ground in a position corresponding to that which is natural in the horse, and the horse is supposed to be in the impossible position of having the whole of the bones from the point of the hock to the last phalanx of the toe on the ground as in the foot of the man. The teaching of the diagram is that for the horse to exhibit a perfect foot, the bones below the carpus (knee) and the tarsus (hock) would have to be included

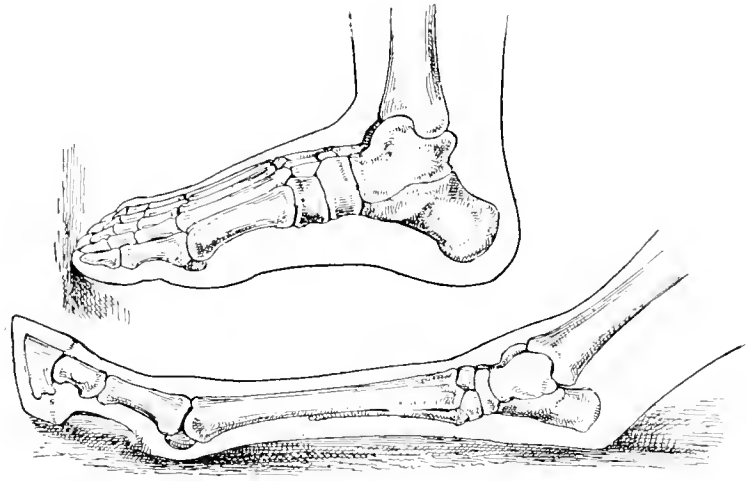


Fig. 659.—Foot of Man and Foot of Horse Compared (positions reversed)
(Note position of ground surface in each case.)

The names of the several bones are given below fig. 658 on the preceding page

in the structures of the organ; instead of this being the case, it is obvious that what is called the foot of the horse only includes the two last phalanges.

It will be noticed in comparing the above illustrations with the skeletons in fig. 655, page 486, that in man the bones of the leg (the tibia and fibula) up to the knee, and the thigh-bone (femur) from the knee to the hip-joint, form a column which is nearly a straight line. The limbs of the horse, on the contrary, present very decided angles at several points, chiefly at the shoulder, elbow, hip, stifle, and hock joints; and also from the fetlock-joints to the ground surface, an arrangement which is eminently calculated to give freedom of movement, and at the same time lessen the effect of concussion.

Muscular System.—The bones of the skeleton form the framework of the body. Joints are obviously arranged to admit of motion, they

do not originate it. That function is relegated to the muscles, which form the masses of flesh covering the bones. Muscular tissue possesses the peculiar property of contraction, and the effect of contraction is to pull the parts to which muscles are attached nearer to each other.

As nearly all the joints of the horse are simply hinge-joints capable only of flexion and extension, it would be expected that only flexor and extensor muscles would be required. It is a fact, however, which Sir W. Flower comments on in his work on the horse, that many more muscles exist in the limbs of the animal than would be thought necessary for the very simple functions which they have to perform. It would appear that the reduction of bones to a rudimentary condition, as in the case of the ulna and the fibula, or their entire loss, as in the case of four of the toes, has taken place more thoroughly than, and in advance of, that of the muscles which were originally connected with these bones, many of which linger, as it were, behind, though with new relations and uses, sometimes in a most reduced, and almost, if not quite, function-less condition, and sometimes even with completely changed structure.

Dr. G. E. Dobson remarks in this connection that if no other evidence were obtainable of the descent of the horse from five-toed ancestors, the condition of the muscles of the foot would be a sufficient indication.

Most of the muscles of the forearm of the five-toed mammal are still represented in the extremities of the horse; the proper extensor even of the fifth digit survives, although both its position and special function have been completely altered.

In the hind-limbs of the horse the two flexors of the great toe and the next one are both present with well-developed tendons united in the foot, as in the greater number of five-toed mammals.

"In the human hand there are fifteen muscles which have special functions in the complicated movements of the organ. Only five[1] of them remain in the horse, four in a very reduced condition, two interossei, and two lumbricales. The fifth muscle, a short flexor muscle, called in man the first palmar interosseous, is referred to as a remarkable instance of a structure not becoming rudimentary and useless, but being completely diverted from its original purpose, its function and its structure also being changed. In the horse the modified muscle is entirely transformed, and in its new form is known as the suspensory ligament—a strong fibrous band lying at the back of the cannon-bone, being attached to its upper extremity, and dividing at the lower end into two portions which spread over the fetlock-joint and are inserted partly into the sesamoid bones and partly into the extensor tendon on the first phalanx."

[1] Others have been discovered in later dissections.

The most interesting point, however, remarks M. D. J. Cunningham, in connection with its structure is that it bears its history on its face. Almost invariably two thin streaks of striated muscular fibre are to be found on its superficial surface, leading down to the two inferior divisions. On examining its deep surface two very distinct strands of pink, fleshy tissue are always observed extending throughout the entire length of the ligament. These consist in each case of short oblique striated fibres, and are presumed to represent the two heads of the muscle called the *flexor brevis*, not yet converted into fibrous tissue. It is hardly necessary to suggest that muscular fibre in such a form and position, and with such surroundings, cannot possess any functional value, that is, does not serve any really useful end. Indeed, it can only be looked upon as a vestigial tissue which is slowly passing away.

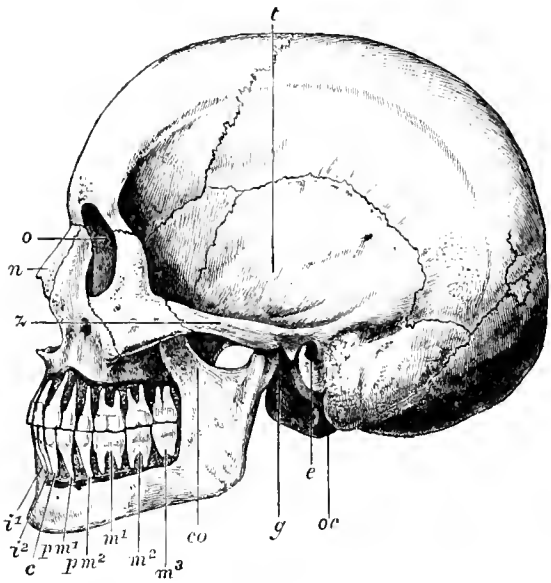


Fig. 660.—Side View of Skull of Man, with the bone removed so as to show the whole of the teeth

z, Zygomatic arch; *n*, nasal bone; *o*, orbit; *t*, temporal fossa; *oc*, occipital condyle; *e*, external auditory opening; *g*, glenoid fossa for articulation of the lower jaw; *co*, coronoid process of lower jaw; i^1 and i^2, incisor teeth; *c*, canine; $p\,m^1$ and $p\,m^2$, premolar teeth; $m^1\,m^2\,m^3$, the three molar teeth.

The Head. — Proceeding from the consideration of the bones of the limbs we will next give particular attention to the head, mainly on account of the teeth. These, although in the popular view they are looked upon merely as organs for masticating food, and for this purpose are divided into front and back teeth or incisors and molars, do really possess very special features, by the aid of which the naturalist is enabled to determine the family or order to which animals belong.

The exploit of the palæontologist in constructing the model of an extinct animal from a single fossil bone or tooth is often accepted as a trick of sleight-of-hand, more calculated to amuse than to instruct, but when all the facts are known there is really nothing very wonderful in the procedure. Anyone, for example, who is familiar with the form of the teeth of the shark could hardly make a mistake in their identification, and if a fossilized tooth of a shark were placed in his hand he would at once, in imagination, construct the animal to which the tooth

belonged—in fact, it would be impossible for him to avoid doing so. In like manner other characteristic structures and organs are in themselves indisputable evidence of their origin, and to the naturalist the realization of the form of an animal upon such evidence is a mere involuntary and quite spontaneous mental process scarcely attended with any effort.

To understand the value of the evidence afforded by the teeth and certain bones of the skull of the horse as connecting the existing animal with its remote ancestors, it will be necessary to consider some of the most salient features of those structures, premising that no more than a cursory view can be taken out of respect for the patience of the reader.

If we compare the skull of man with that of the horse it will at once be evident that the difference of form is very marked, as shown in the two illustrations (figs. 660 and 661) from Sir W. Flower's book.

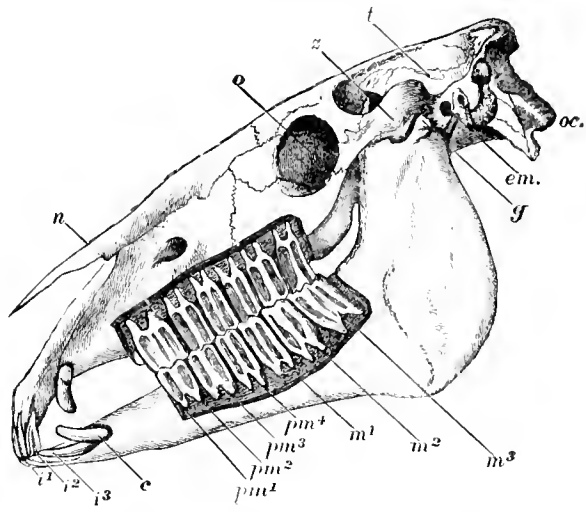


Fig. 661.—Side View of the Skull of the Horse, with the bone removed so as to show the whole of the teeth and nasal bone

n, Nasal bone; *o*, orbit; *z*, zygomatic arch; *t*, temporal fossa; *oc*, occipital condyle; *e m*, external auditory opening of glenoid fossa for articulation of the lower jaw; i^1 i^2 i^3, three incisor teeth; *c*, canine; *p m'*, the situation of the first rudimentary premolar, which has been lost in the lower, but which is present in the upper jaw: $p\,m^2$ $p\,m^3$ $p\,m^4$, the three fully-developed premolar teeth; m^1 m^2 m^3, the three true molar teeth.

The letters of reference in the two figures are the same in both, and indicate the same bones. The remarkable difference in form of the two skulls is due to the variation in size and shape of the separate pieces of bone of which the cranial and facial divisions of the skull are composed.

Most noticeable is the vast difference in size of the cranium of man as compared with that of the horse. There is no difficulty in recognizing the fact that the facial division of the horse's skull, the part which is mainly used for the mastication of the food, is developed enormously out of proportion to the cranial division in which the brain is lodged—the centre of whatever degree of intelligence the animal may possess, and the source of some of the most important nerves. In man the conditions are exactly the opposite. The cranium is of immense capacity compared with the insignificant proportions of the facial bones, yet it

is a fact that there are the same number of bones and a similar arrangement of them, and in short a general uniformity of the plan of construction in both cases, varied in details under the influence, it may be presumed, of the conditions of existence.

With regard to the teeth of the horse some points of considerable interest have to be noticed. It has already been stated that the horse has six front teeth or incisors, named more correctly, from their flat surfaces, *nippers*, in each jaw, four canine teeth (*tusks*) in the male, two on each side, top and bottom, while in the female the tusks are absent or are in a rudimentary condition. There are also six molars on each side, top and bottom. The last three of these are specially distinguished as the molars, those in front being known as *premolars*. To these must be added the first premolars, eye-teeth or wolves'-teeth, in the upper jaw, which are in a rudimentary state, and have disappeared entirely from the lower jaw. In the ancient ungulate mammals the first premolars were fairly well developed teeth, making a row of seven instead of six molars. After a gradual diminution in size, which may be traced in the fossilized remains of the ungulates of the tertiary formation, these teeth are represented in the horse of the present time only by the small conical teeth in front of each of the first well-developed molars of the upper jaw. These teeth (the eye-teeth)—which, as is well known, were once (and are still by some) looked upon as a cause of blindness, and were always punched out as soon as discovered—are undoubtedly therefore vestigial remains, and in course of time may cease to appear altogether in the horse's mouth. They are usually got rid of between two and three years of age, when the two first molars are exchanged for the second teeth or permanent molars.

Between the corner incisors and the first molars is a clear unoccupied space, the *diastema*, popularly called *the bar*. This toothless space did not exist in the most ancient mammals, but in the primitive equine ungulates there were some indications of it, and the feature becomes more and more distinct through the whole series of horse-like animals. What circumstances led to the change, or what object is gained by it, is not known, but in the horse the space in the lower jaw is taken advantage of for the purpose of adjusting the bit. The incisors and molars of the horse are remarkable for their complicated structure. Three materials of different degrees of density may be distinguished in their formation. Of these the least dense is known as the *crusta petrosa* or *cementum*; the next in hardness forms the bulk of the tooth, and is called *dentine*; the hardest of the three is the *enamel* which covers the dentine, following it in all its convolutions. The crusta petrosa

covers the root of the tooth; it consists of lamellated bone tissue, with lacunæ and canaliculi, but without haversian canals. It is covered with periosteum, which is also reflected on to the walls of the alveolar cavity.

In the incisor tooth of the horse there is no external dentine: the crown of the tooth is enamel and crusta petrosa (fig. 662). In the molar tooth affairs are different; crusta petrosa, dentine, and enamel all come to the surface, and it is owing to the different degrees of hardness of these substances that the necessary roughness of surface is maintained, as the crown is worn away by use.

Not only do the three structures of the teeth accomplish an important purpose in the preparation of the food for digestion, but owing to variation of colour they present a characteristic appearance which, taken in connection with the form of the teeth, constitutes a distinguishing feature in the *Equida* or horse family easily recognized and quite reliable.

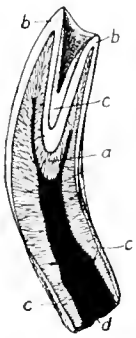


Fig. 662.—Section of Unworn Incisor of Adult Horse.

a, Dentine; *b*, Enamel; *c*, Cementum; *d*, Pulp cavity.

With the above sketch of some of the special parts of the skeleton of the horse it will be convenient to proceed to the examination of some other characteristics which are exhibited by the animal.

Colour may attract the attention of an observer even more than variations in size and outline, and in many instances the peculiarities which are recognized on the surface are more definite, and certainly to the ordinary observer more intelligible, than the evidence which the anatomist obtains from a close examination of internal parts.

For example, some six or seven species of the equine family may be distinguished by mere inspection of the markings on certain parts of the skin, the arrangement of the hair of the mane and the tail, the size and the shape of the feet, the length of the ears, and the existence or the absence of small horny callosities on the fore and hind extremities.

The horse (*Equus caballus*, as it is known to naturalists) is variously coloured, and to the observant eye has very curious markings, often spots or stripes here and there. On the tail the hair is long, and grows from the root to the tip of the organ, covering it completely. The mane also is eminently characteristic, especially that part of it, the forelock, which hangs between the ears over the forehead.

Peculiar markings are also frequently seen in the form of a spot, light or dark in colour, on the centre of the forehead. This mark varies in form, is circular or oval, elongated or lozenge-shaped, and sometimes occupies a considerable space, forming a kind of shield over the whole front of the face. *Blaze* or *race* is the term given to this mark.

Size.—One horse differs from another not only in the characteristics described, but even to a much greater extent in size. Comparing the smallest pit pony of thirty-six inches with the carriage or the cart horse of eighteen or nineteen hands, it is often difficult to realize that both belong to the same species. Nevertheless the apparently widely different animals are in all essential features, excepting in size, the same. The vast difference in bulk is largely due to the efforts of the breeder in applying the principle of artificial selection. Pit ponies are required to work in mines where the seams are only a few feet high; large horses are wanted for special work or for appearance. Both requirements must be met, and the skill of the breeder, aided by climate and by food, is equal to the demand.

The Ass.—Next to the horse (*Equus caballus*) comes the ass (*Equus asinus*) with its varieties, which include the zebras. Naturalists affirm that really wild horses are rare, *i.e.* horses which have descended directly from parents which have never been domesticated. Wild asses, on the contrary, are common in many parts of the world—in Africa, in Syria, in Persia, in Tartary, in Tibet, up to the frontier of China.

Though asses have a general resemblance to each other, they still differ so far in size, in form, and in shade of colour or of markings as to justify their division into three varieties.

The domestic ass presents some features which require notice. Its size varies in different countries, as also does its colour. The tail is bare of long hairs, excepting the tuft at the end. The ears are longer in comparison with its head than those of the horse, and there are no callosities below the hock joint as there are in the horse. There is commonly a dark stripe running vertically from the top of the shoulder, and another darker in colour extending along the middle of the back, and occasionally there are transverse markings on the legs.

Zebras (*Equus zebra*) belong to the group of striped asses. There are several varieties, which are distinguished by the length of the ears, by the fulness of the tail and the mane, by the colour and the arrangement of the stripes, by the absence of the callosities on the hind-leg, and by the existence of a modified form on the fore-legs. Quaggas (*Equus quagga*) are really modified zebras, from which they are chiefly distinguished by the concentration of the stripes on the head and the neck, the markings being less and less distinct from the shoulders back to the haunches, which are perfectly free from stripes. All the varieties of the ass agree in having the horny callosities in a modified form only on the fore-legs. With regard to these bodies, which have attracted so much attention and led to so much diversity of opinion as to their nature and

uses in the animal economy, something has to be said in connection with the subject of *coloration* and skin-markings, of which these curious bodies form an important part.

SKIN MARKINGS AND CALLOSITIES OF THE HORSE

Skin Markings.—Dr. E. Bonavia, in a recent work entitled *Studies in Evolution of Animals*, takes a decidedly original view of the nature of the skin markings, such as spots, rosettes, and stripes on the bodies of various mammals. He holds that the action of the nerve-centres has more to do with the remarkable variations of colours and of markings in animals than natural selection has; and there can indeed be no doubt that the nervous system does operate largely in determining colour in some cases, because the fact has been demonstrated. Jacob's device of putting straked rods in view of the flock which he was attending, in order to secure a liberal proportion of straked animals for his own share, was palpably successful, and more recent experience has shown, to the breeder's cost and annoyance, that the determining effect of colours on the imagination of animals through the eyesight is often marked. Further, Dr. Bonavia shows in numerous illustrations how easy it is for spots to be resolved into rosettes and these to be fused together so as to form stripes. A visit to the collection of stuffed animals in the Natural History Museum, London, would make all this quite clear, even to the untrained eye; and an extension of the enquiry to the reptile room might assist in disposing of a good deal of the hesitation which might be felt in accepting Dr. Bonavia's rather startling suggestion that all the markings spoken of, and others yet to be considered, are to be explained by referring them to what he deems to be the real origin of marked mammals—the armour-plated ancestor of the armadillo, of which family the illustration (fig. 663) will afford a good example.

In the figure the reduction of size necessarily disturbs the impression of similarity of markings in the variously spotted mammals and the armadillo, but anyone looking at the huge carapace of an armadillo in the Natural History Museum could hardly fail to see an excellent pattern for the marking of many spotted and speckled creatures.

Dr. Bonavia sums up his views of the nature of coloration of mammals in a few short sentences.

"Glyptodonts, or other armoured mammals," he writes, "were the originals from which all mammals are descended. The jaguar has retained the most primitive type of coloration due to the characters of the ancestral armour-plates—a sort of *picturation* of the carapace after it had been got rid of entirely.

"All other spotted mammalia, whether marked longitudinally, transversely, or diagonally, are modifications of the jaguar.

"Stripes, whether longitudinal, transverse, or diagonal, are fusions of lines, of spots, or of rosettes; witness the spotting of certain cheetahs, of certain horses, and of certain tigers with twin stripes."

In the self-coloured mammals, Dr. Bonavia contends, there is evidently a total obliteration of all special markings, though they now and then turn

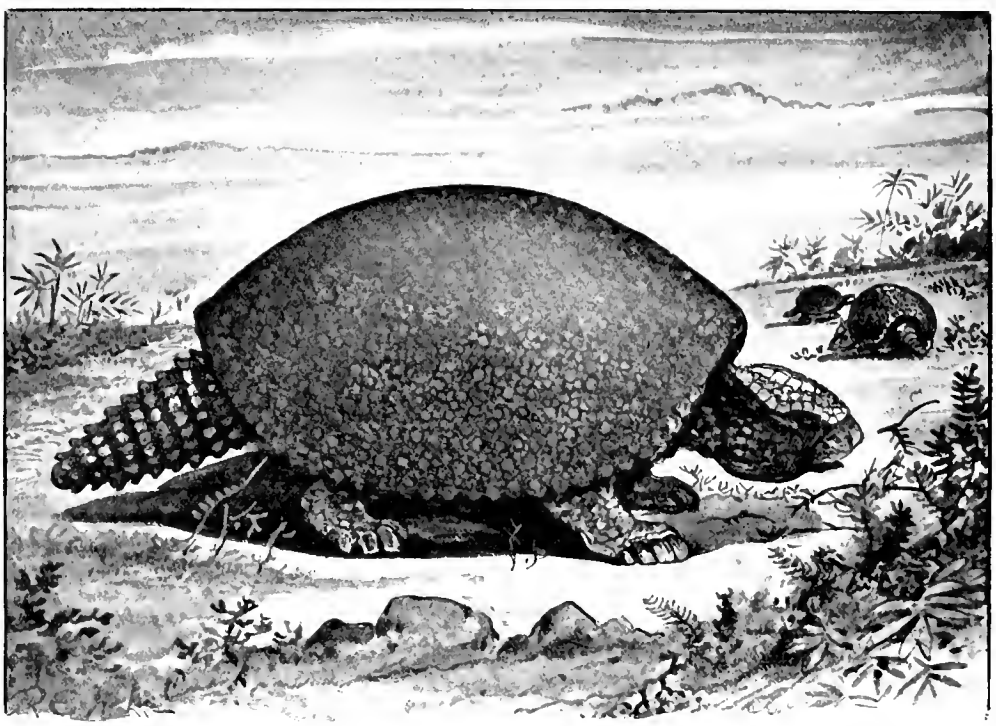


Fig. 663.—*Glyptodon reticulatus*, restored from the remains exhibited in the Natural History Museum, South Kensington

up as atavic or ancestral marks, due perhaps to some atomic change or crossing in the nerve-centres.

Proceeding to the subject of coloration as it affects the horse, the animal which is most immediately under consideration, it is at least very remarkable to observe the curious mixture of colours in roan, piebald, skewbald, grey, and dappled horses—the last term indicating a peculiar pattern irrespective of colour, as the dappling occurs in bay, brown, grey, and dun-coloured horses.

It appears from the experience of breeders that dappled foals are unknown, the peculiar marking appears as the animal gets older, and it must be admitted that in the figures in the accompanying plate (LXVIII)

MR. ARMOUR'S TEAM OF DAPPLED GREYS

DAPPLED GREY GELDING

The property of Messrs. S. Allsopp & Sons

the light spots are singularly suggestive of the plates on the carapace of a large armadillo. In fact, the markings are exactly what would be expected to remain if the armour-plates became loose and ultimately fell off, leaving on the skin only the impression of their outlines.

No proof of such a change having taken place in the course of ages can be offered, probably none exists, but it may at least be urged that there would be nothing very remarkable in the change, given that the doctrine of evolution is true. On this point Dr. Bonavia remarks that it would be as idle to suppose that the bony plates of the armadillo, the hide plates of the rhinoceros, and the picture plate of the horse are all so like each other by mere accident, as it would be to suggest that the seven cervical vertebræ or neck bones, which they possess in common, came to them by chance.

Markings on the face of the horse, before referred to, in the varied forms of the so-called *blaze* or *race*, which are always present to a greater or a less extent, varying in size and in colour, can be accounted for on the same principle, as also may similar patches of colour or absence of colour in other parts of the body, round the eyes, on the nose, and on the lower parts of the extremities. And it is also the case that the upper portions of the body are commonly of a darker colour than the under portions. All these variations, according to Dr. Bonavia, may be explained, if his theory that the horse is descended from an armour-plated ancestor is correct. The lighter colours would indicate the parts from which the armour-plates had first disappeared, leaving only the pictures behind them, and it would naturally happen that the most movable parts, or those most subject to friction, would first get free from the hard plates which, while they protected the parts they covered, would at the same time impair their motion. Thus the eyelids, the limbs, and the terminal extremities would be most likely to be freed earlier than the upper parts of the body, and on the same principle the friction which the abdominal region would suffer, when the animal was lying on the ground, would tend to assist the removal of the armour. The fact of the front of the head being most exposed to rubbing against branches of trees and other projecting bodies would account for loss of armour from that part.

That the process of removal of the armour-plates must have been a gradual one, originated and modified by changes in the conditions of life, cannot be doubted; and, in addition, natural selection, absolutely unchecked by any restraining influences, would inevitably conduce to various alterations in the size and the shape of the picture-markings, exactly as artificial selection does in the present day, with the recognized exceptions which from time to time upset the breeder's calculations through the operation of the law of atavism, or reversion to some ancestral type. It does not, however, at all times occur to the breeder so strongly as it might, that a red calf, or

one of any other colour, instead of the expected black one, or a foal with a large white blaze when only a small spot was desired, is not a freak of nature, but the consequence of a sternly enforced law of heredity which never dies, although it may seem to slumber now and again.

Callosities (Chestnuts and Ergots).—Of all the peculiar markings which have been referred to, the most remarkable and least explicable are the horny growths or callosities on the inner sides of the legs and the backs of the fetlock-joints of horses and their allies. It has been remarked by an American naturalist "that whoever discovers the meaning of the horse's callosities will become famous among naturalists all the world over". Why so much thought and speculation has been devoted to these bodies is not at all easy to understand. They are so placed inside the forearm and at the lower and back part of the hind-leg, just below the hock and behind the fetlocks, that they are quite out of the way. They are never affected by or connected with any disease, and when they grow long enough to be unsightly, as they sometimes do, the shoeing-smith pares them down with his knife, just as he pares the sole of the foot. In size the horny structures vary from that of a hazel-nut to that of an oval mass nearly 3 inches long and 1½ inch broad in the centre in coarse-bred horses. Their shape is most commonly an elongated oval, those in the fore-legs being larger and more distinctly pear-shaped than those in the hind-legs. Some of the earlier veterinary writers—Snape (1687), Bracken (1739), Gibson (1751), Blaine, and also James White (1802)—do not mention the chestnuts, although Gibson figures them in his plates of the limbs of the horse in the fore-arm, but not in the hind-legs.

In a later edition (1832) Blaine ascribes to the chestnuts a fanciful value as adjuncts to the generative organs of the stallion, apparently disregarding the fact that they are quite as well developed in the mare. Chauveau, in his *Comparative Anatomy* (1873), refers to the chestnuts as little horny oval or round plates found in the horse in the inner face of the forearm, and at the upper extremity of the inner surface of the metatarsal bone. They are composed of a mass of epithelial cells, arranged in tubes like the horn of the hoof. "In solipeds," it is said, "the chestnut is the representative of the thumb.

"In fine-bred horses this horny production is much less developed than in coarser breeds. It is always smaller in the hind-limbs.

"In the hind-legs and the fore-legs we also find a similar but smaller horny mass growing from the skin in the tuft of hair behind the fetlock, and named the ergot. Like the chestnut, it bears the same relative development in fine-bred and in coarse-bred horses." This is all that Chauveau has to say on the subject.

Sir William Flower combats the view which has been very generally accepted, that the callosities are the remains of the first digits, and his argument is well worth attention. After a concise description of the skin, with its inner layer of interlacing fibres, blood-vessels and nerves, and glands and follicles, constituting the true skin, and the layer of flattened cells which form a protecting layer of insensitive structure—the epidermis or cuticle,—the author refers to the hairy coat of the horse, with its varieties of fine and coarse hairs; the "chestnuts" are described as "mallenders" and "sallenders", with the remark that they are treated as a disease by the older veterinary writers. It is true that these words are used by ancient and modern veterinary writers to indicate an eruptive affection in the bend of the knee-joints and hock-joints respectively, but the terms have never been applied by them to the horny excrescences called chestnuts or callosities.

Sir W. Flower's chief objection to the view that the chestnuts are rudimentary digits is based on the fact that in the case of the excrescences which are most constant—those on the fore-limbs—the position which they occupy on the forearm, at some distance above the knee, is quite inconsistent with the theory that they represent the thumbs.

Sir W. Flower concludes "that the callosities belong to a numerous class of special modifications of particular parts of the skin surface which occur in many animals, the use of which is in most cases remarkably obscure. Bare spots, thickened patches or callosities, and tufts of elongated or modified hair, often associated with groups of peculiar glands, are very common in various parts of the body, but especially in the limbs of many ungulates, and to this category the chestnuts of the horse undoubtedly belong."

A somewhat similar horny excrescence has already been mentioned as existing at the back of the fetlock of the horse, hidden by the tuft of long hairs which give the name feetlock or fetlock to the joint. To this excrescence, owing to its growth occasionally in the form of a spur, the term ergot is applied, and with regard to its significance Sir W. Flower suggests that it corresponds to the foot-pads of animals which walk more or less on the palm and the sole. As no one has previously offered any explanation of the uses of the horny growths at the back of the fetlocks, it will be interesting to give Sir W. Flower's description verbatim. "If we look at the palms of our own hands (which, as shown before, correspond with the hinder surface of the fore-limb of the horse below the so-called knee) we see slight prominences just behind the root of each finger and opposite the knuckles at the back of the hand, which mark the position of the joint between the metacarpal bones and the first phalanges of the digits. Over these, especially when the palm is subject to pressure and friction from hard manual labour, the

epidermis is thickened. The sole of the foot presents exactly the same arrangement.

"In such an animal as a dog or a cat, in which this part of the foot comes to the ground in walking, there is a large, trilobed, prominent, bare pad, composed of a thick, fatty cushion covered with hardened epidermis, generally of a black colour. There are also smaller pads in front of this on the under surface of each of the toes, but the large one corresponds with the coalesced three middle prominences of the human palm or sole just noticed.

"In the horse's nearest relatives, the tapir and rhinoceros, the same arrangement holds good. There is a large pad under the fore part of the middle of the foot, which in these animals rests on the ground, and there is also a hard sole under each toe. Now the ergot of the horse clearly, both by structure and position, corresponds to the palmar or the plantar pads of those animals which walk more or less on the palm and the sole.

"Owing to the modified position of the horse's foot, standing only on the end of the last joint of the one toe, this part of the foot no longer comes to the ground, and yet the pad, with its bare and thickened epidermic covering, greatly shrunken in dimensions, and concealed among the long hair around, and now apparently useless in the economy of the animal, remains as an eloquent testimony to the unity of the horse's structure with that of other mammals, and its probable descent from a more generalized form for the well-being of whose life this structure was necessary."

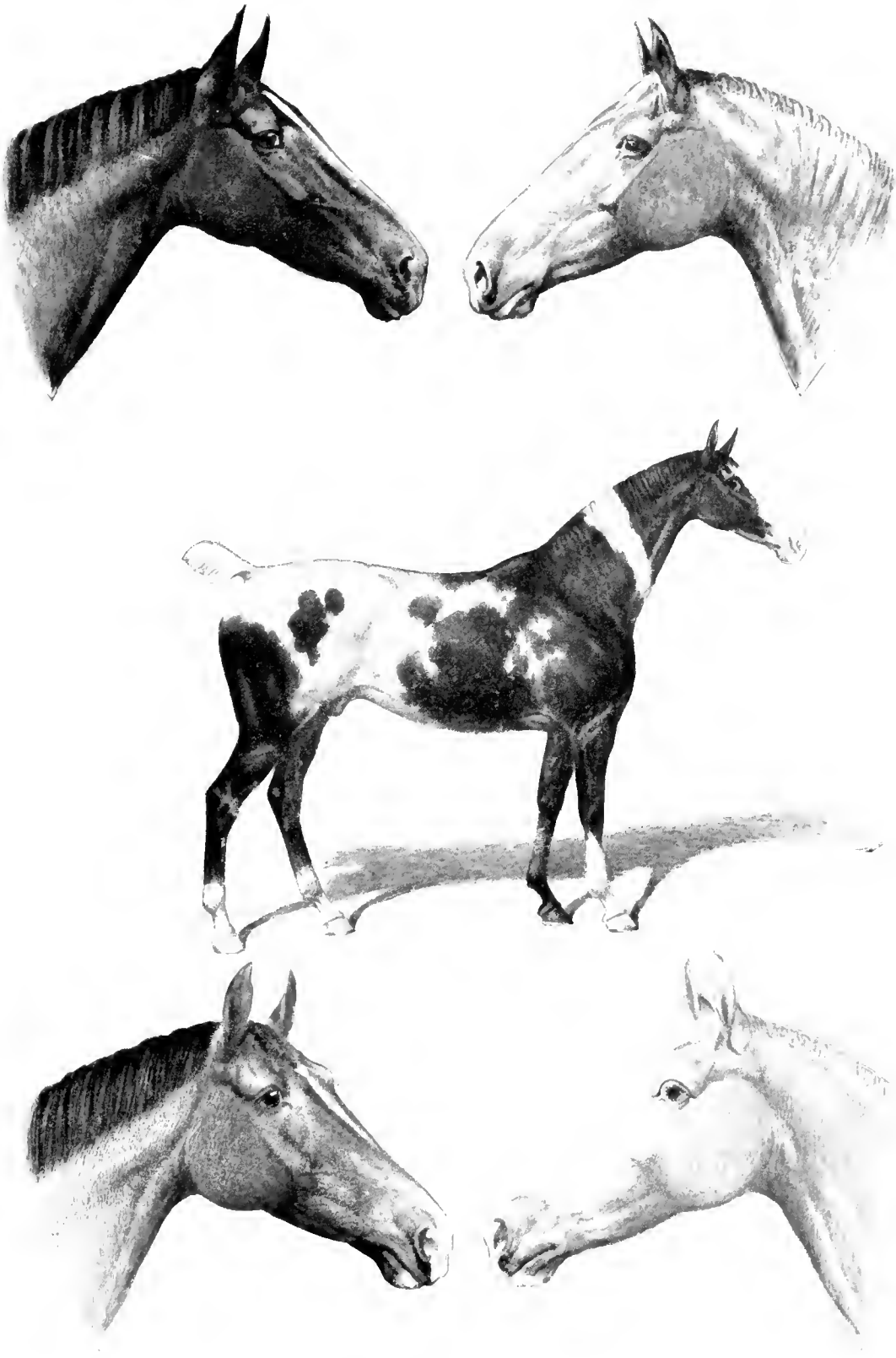
In the illustration (fig. 664) the position of the parts described is shown.

In the description quoted, the reference to the ergot of the horse's fetlock—representing the palmar or plantar pad—as being characterized by "its bare and thickened epidermic covering greatly shrunken" does not convey an idea of its true structure. The excrescence, both in the horse and in the ass, is a decided prominence, and is identical in its minute structure with the hoof of the horse, as will shortly appear, while the palmar and the plantar pads of man and the dog are correctly described as "thickened epidermic covering" quite distinct from hoof horn.

A careful examination of specimens which have been obtained for the particular purpose of ascertaining what are the structural relations between the callosities and the ergots of the horse tribe and the plantar and the palmar pads in man and the dog has led to some very interesting results.

The several parts referred to may, for convenience, be considered in the first place as they appear to the unaided eye of the observer. After which their minute structure will be more easily explained.

Man has no distinct pads beyond those which have been described as hardened cuticle, the result of pressure and of friction affecting certain prominent parts of the soles of the feet and the palms of the hands. These



SKIN MARKINGS—II

Blue Roan, White Stripe — Gray

Piebald

Red Roan, White Stripe — Cream

points are indicated in the human feet A in fig. 664 by the letters *a b c*. To the unaided eye the parts referred to are apparently covered with a hard mass of cuticle, and a microscopic examination confirms this conclusion.

In the dog the palmar and the plantar pads are underneath the fore-feet and the hind-feet B, fig. 664. Two fatty cushions form the bulk of each pad, and the surface of the skin covering the cushions is an extremely beautiful structure, to which the use of the term hardened epidermic covering, although strictly correct, certainly does very scant justice.

Looking at the surface of any one of the pads underneath the foot of the dog, when it is freed from the habitual coating of dirt, the observer will be struck by its tessellated or chequered appearance. A series of columns or cones will be distinguished, with the points directed, in the natural position of the foot, downwards to the ground surface of the pad.

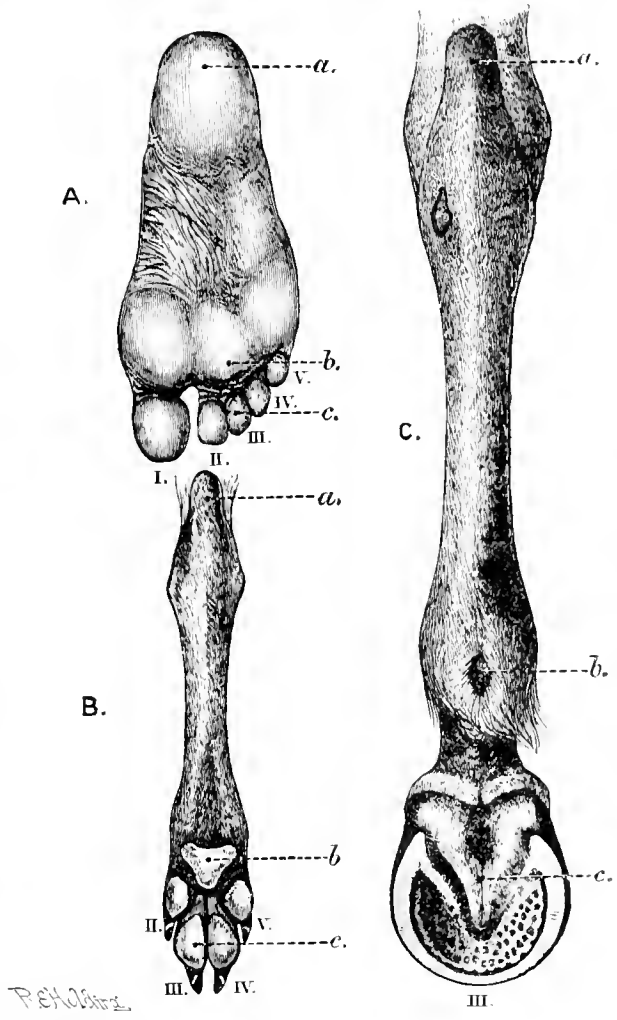


Fig. 664.— Plantar Surface of the Foot of—A, Man; B, Dog; C, Horse

The small letters *a*, *b*, and *c* indicate the corresponding points of the three. These points are in man at the centre of the heel *a*, the protuberance at the joint of the third or middle toe *b*, and in the centre of the middle toe *c*. In the dog at the back of the point of the hock *a*, which does not come in contact with the ground owing to the position of the limb, also on the centre pad *b*, and on the centre of the third toe *c*. In the horse in the centre of the point of the hock *a*, on the ergot *b*, and near the centre of the frog *c*.

The plantar pad of the foot of man is composed of epidermic scales, forming a nearly smooth covering to the sensitive and vascular skin.

Among the horse tribe there are no developed palmar or plantar pads; the remains of these are indicated in C of fig. 664. If, however, the ergots

are to be accepted as the rudiments of the plantar pads in the primeval horse, it must not be forgotten that they differ in structure from the pads of animals in which pads are essential organs of progression, as the ergots are distinctly horny structures and not merely hardened cuticle.

Ergots are constantly present in horses and in asses; in the latter indeed they are relatively broader than in the horse, although they do not often protrude quite as far above the skin. After maceration the horny growths are easily pulled off, and even a naked-eye inspection suffices to prove their identity with horn of the sole or coronary surface of the foot.

Chestnuts or callosities are met with in different forms and in varied positions in the several members of the equine family. In the horse, breeding exercises some considerable influence on their development, and in their earliest condition in the fœtus they are not at all like the horny excrescences which they afterwards become, but, on the contrary, correspond strictly to the description given of them in the other equidæ, *i.e.* bare patches of skin with a thickened epidermic covering. It is interesting to note, however, that their true nature is at once ascertained by microscopic examination.

Among asses, chestnuts are usually found in the distinctly modified form described—*i.e.* bare patches of skin, often rather larger and more circular in form than the chestnuts of the horse,—and to the naked eye are covered with thickened epidermis. It may be added, however, that in some specimens of chestnuts recently obtained from asses the horny substances projected something like $\frac{1}{4}$ of an inch above the surface of the skin, in fact they were larger than some which have been lately obtained from the legs of well-bred horses.

In the following illustrations (fig. 665) are represented a chestnut from the fore-leg of a cart mare and one of the ergots from the fetlock joint; also specimens of a chestnut or bare patch from the fore-leg of an ass and one from the fore-leg of a fœtus of a mare at about the eighth month of gestation.

To the naked eye the chestnuts of the ass and those of the fœtus of the mare are identical in appearance, differing altogether from the chestnuts of the adult horse; but under the microscope the three forms are seen to be essentially the same in their minute structure (Plate LXIX).

That all the cuticular appendages, hair, nail, and horn, are composed of epidermic cells arranged in various ways is quite well known. To assert, therefore, in respect to any of the structures, that they are hardened, condensed, or modified cuticle is correct; at the same time the statement is not sufficiently definite from the point of view of the scientific enquirer.

Cuticle or epidermis is arranged in the manner of the tiles or the slates on the roof of a building, each cell representing a tile.

Horn is formed by the secretion of cells round a cone or *villus* projecting from the underlying vascular membrane, and assumes in consequence the form of hollow fibres closely felted together.

Hair is developed in a similar manner from a papilla at the bottom of a small depression or follicle, the chief difference being that each of

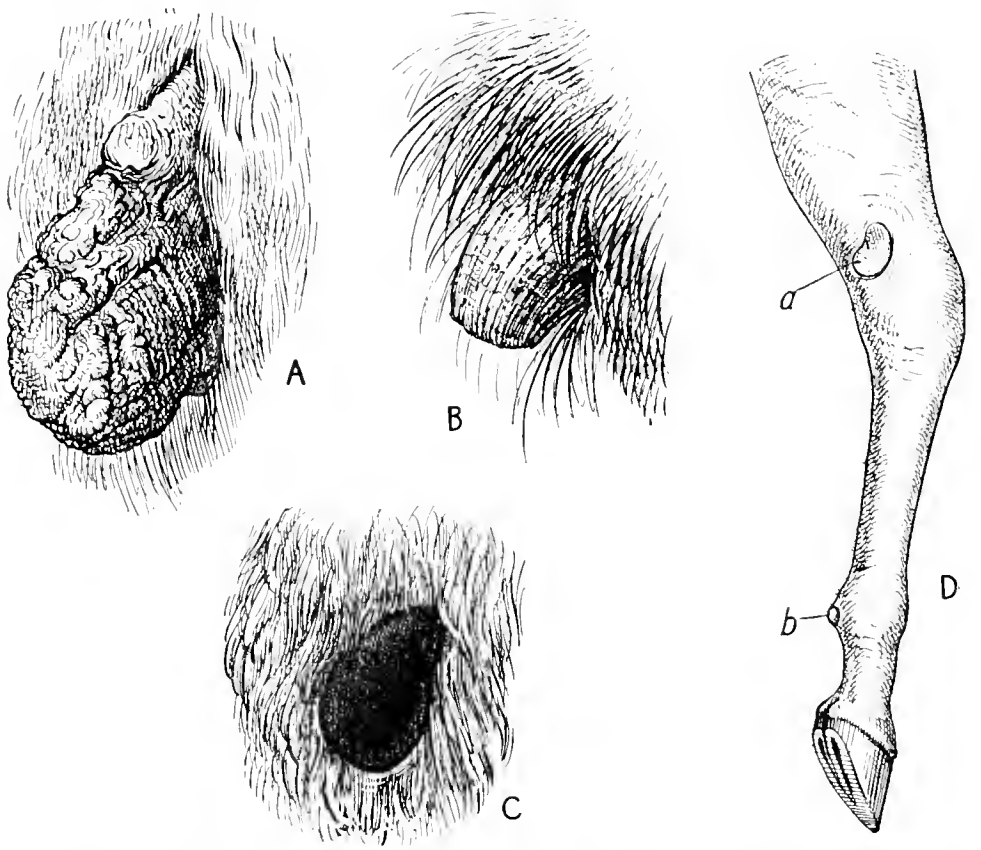


Fig. 665.—A, A large chestnut from a cart mare. B, Ergot from same animal. C, Bare patch from fore-leg of an ass. D, Bare patch from fœtus of mare. All about $\frac{2}{3}$ of natural scale. *a*, Chestnut; *b*, Ergot.

the hairs is distinct. They are not felted together or arranged in masses, as in horn.

Nail is also formed from a villous membrane, the fibres being very fine, and densely crowded together, constituting an extremely hard structure.

Although hoof, hair, and nail are all composed of the same elements, the difference in their arrangement is so distinctive that a tyro in the use of the microscope finds it a perfectly easy task to recognize and to name the several structures when placed before him.

The present enquiry is to ascertain the structure of those peculiar formations on the legs of the horse family, known as chestnuts, ergots, and bare patches of cuticle, and also of the parts described as plantar and palmar pads in man and certain animals, with the view to placing them in the classes of substance to which they respectively belong.

Perhaps the most simple way of performing the task will be to classify the several structures at the commencement, and then to show by description and illustration how the classification has been arrived at.

Proceeding on this plan, the structure classed as horn will include all the growths known as chestnuts, ergots, and bare patches of hardened cuticle, notwithstanding the decided variations of form which they present to the naked eye.

In the next class—"Modified epidermic covering"—must be placed all the varieties of plantar and palmar pads.

Taking the chestnuts or ergots of the horse first, both in the adult and in the fœtus near the time of birth, there is no difficulty in showing that they are horny structures. The sections, both transverse and vertical, exhibited in the following diagrams (fig. 666) and in Plate LXIX place the matter beyond doubt, and it will be interesting to compare the different sections with the objects as they appear to the naked eye in fig. 665, A, B, C, D. The bare patches covered with hardened cuticle in the ass, and the similar bare patches in the fœtus of the mare, are, as previously stated, both quite distinctly true horny structures developed from a villous membrane, exactly as the perfectly formed horny excrescences (chestnuts) are in the adult.

After maceration in water in the case of the chestnuts of the ass, and without any preparation in those of the fœtal horse, or of the foal at birth, the epidermic covering may be stripped off, and with a pocket lens the secreting membrane thus exposed may be seen covered with villi. The thin layer which has been stripped from it may by the same instrument be resolved into a fine plate of horn identical with the horn of the sole. Transverse and vertical sections under the microscope show all the details of the structures, the sudden transition from ordinary skin to the villous secreting membrane and the horny covering on the surface. All these parts are indicated in the figures referred to, which may be taken to represent the minute structure of the organs exhibited in fig. 665, A, B, C, D.

Sections of the ergot in the horse and in the ass exhibit exactly the same intimate structure. In fact they differ only in the size and form of the horny growth. No further proof can be required in support of the statement that chestnuts and ergots, whether they appear as horny excrescences or as bare patches of hardened cuticle, are in their minute

structure identical with hoof horn, and further, that the membrane from which they are developed is a vascular villous membrane, precisely analogous to the villous membrane of the coronary surface and sole of the horse's foot, which has already been described and figured on pp. 434 and 435 of this volume.

These facts would have consisted remarkably well with the theory of their being remnants of digits, were it not for the cogent objections which

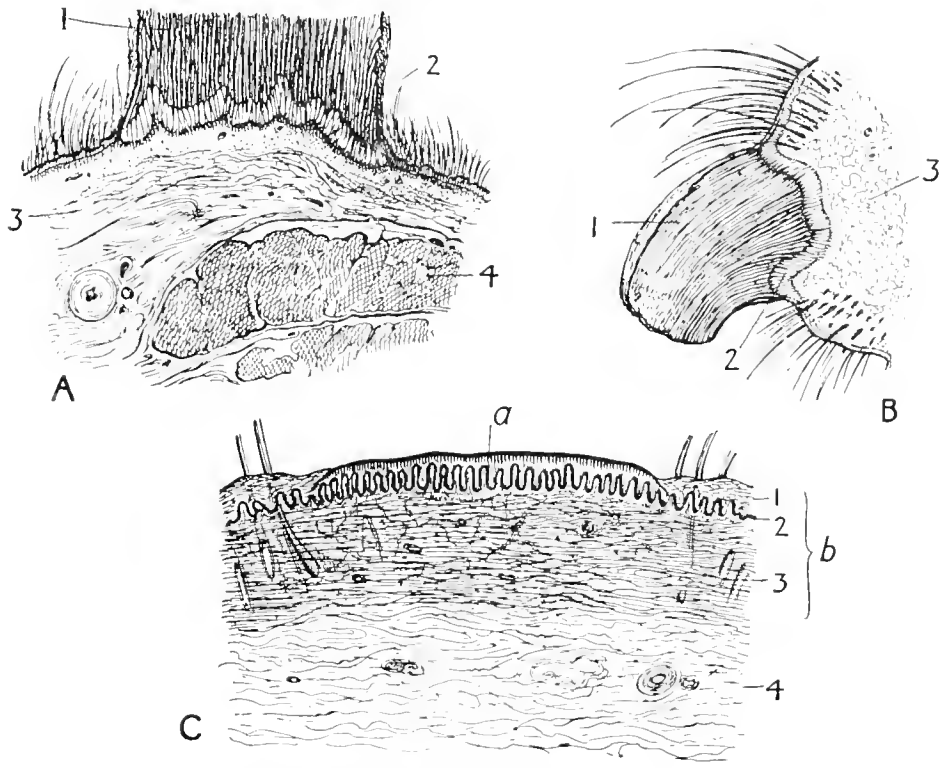


Fig. 666.—Sections of Chestnut and Ergot of Horse and Bare Patch of Ass

A, Horizontal section through chestnut of horse—1, horn; 2, villous secreting membrane; 3, subcutaneous tissue; 4, muscle. B, Perpendicular section through ergot of horse—1, horn; 2, villous secreting membrane; 3, subcutaneous tissue. C, Section through bald patch of ass: *a*, the bare patch; *b*, skin—1, horny layer of epidermis; 2, malpighian (mucous) layer of epidermis; 3, derma; 4, subcutaneous tissue.

have been urged against that view. As it is, the identity of structure in the horny growths and the horn of the foot does not tend to assist in the attempt to assign to them any special economy, or in any way to indicate what functions they might have possessed in their more developed condition.

Plantar pads are represented in fig. 664, A, B (p. 503) in man and dog, and their corresponding positions in the leg and foot of the horse are indicated at c in the same figure. It has been stated already that these

pads in man are really hardened cuticle, excessively thick portions of the cuticle in fact.

In the foot of the dog, however, both on the surface and in section, the structure differs from the thickened cuticle of man's hand and foot, and also from true horn. Indeed, the minute anatomy of the organ exhibits a most perfect type of the transition or change from cuticle to horn. (See Plate LXIX.)

In the case of the dog the plantar and palmar pads are in perfect form and active function. In man, however, they are more or less accidental or rudimentary. The palmar pads, or those on the palm of the hand, depend for their development on the amount of manual work done, and they vanish when that work ceases, while the growth of the plantar pads is checked by the devices of civilization, including shoes and stockings, and the use of various modes of locomotion in place of the natural acts of running and walking.

FALSE NOSTRILS AND GUTTURAL POUCHES

Two peculiarities in the anatomy of the horse yet remain to be considered. The *False Nostrils*, as they are called, and the *Guttural Pouches*.

It is generally known to horsemen that the horse breathes solely through the nostrils, owing to the great depth of the soft palate, which entirely cuts off the cavity of the mouth from the opening into the breathing tubes. In compensation the nostrils are flexible, and the opening on each side is large enough to admit all the air which the animal requires for breathing under all conditions, which include violent exertion and a high rate of speed. A curious pouch, 3 or 4 inches deep, cone shaped, having its apex pointing upwards, and known as the false nostril, exists at the entrance to the nasal chambers on each side. No use can be found for this cavity. The tapir has the same structure in a more highly developed form, and it also exists in the rhinoceros.

To discover the real significance of this peculiar sac is now impossible; most probably it was an important organ in some of the earlier hoofed mammals, but unhappily the conservative earth only preserves in a fossil state the bones and like resistant structures. All that might be learned from even badly-kept soft parts has been lost to us, but the organ as we now find it in the three animals named is valuable as connecting the creatures of to-day with those of other times.

Guttural pouches (Vol. I, p. 505) are cavities at the back of the mouth, also communicating with the air-passages, and with a canal which enters

MICROSCOPIC STRUCTURE OF PLANTAR PADS, CHESTNUTS, AND ERGOT

1. Section of Plantar Pad of Man (20 diameters).

2. Section of Plantar Pad of Dog (25 diameters).

3. Chestnut of Fœtus of Mare, early stage (180 diameters).

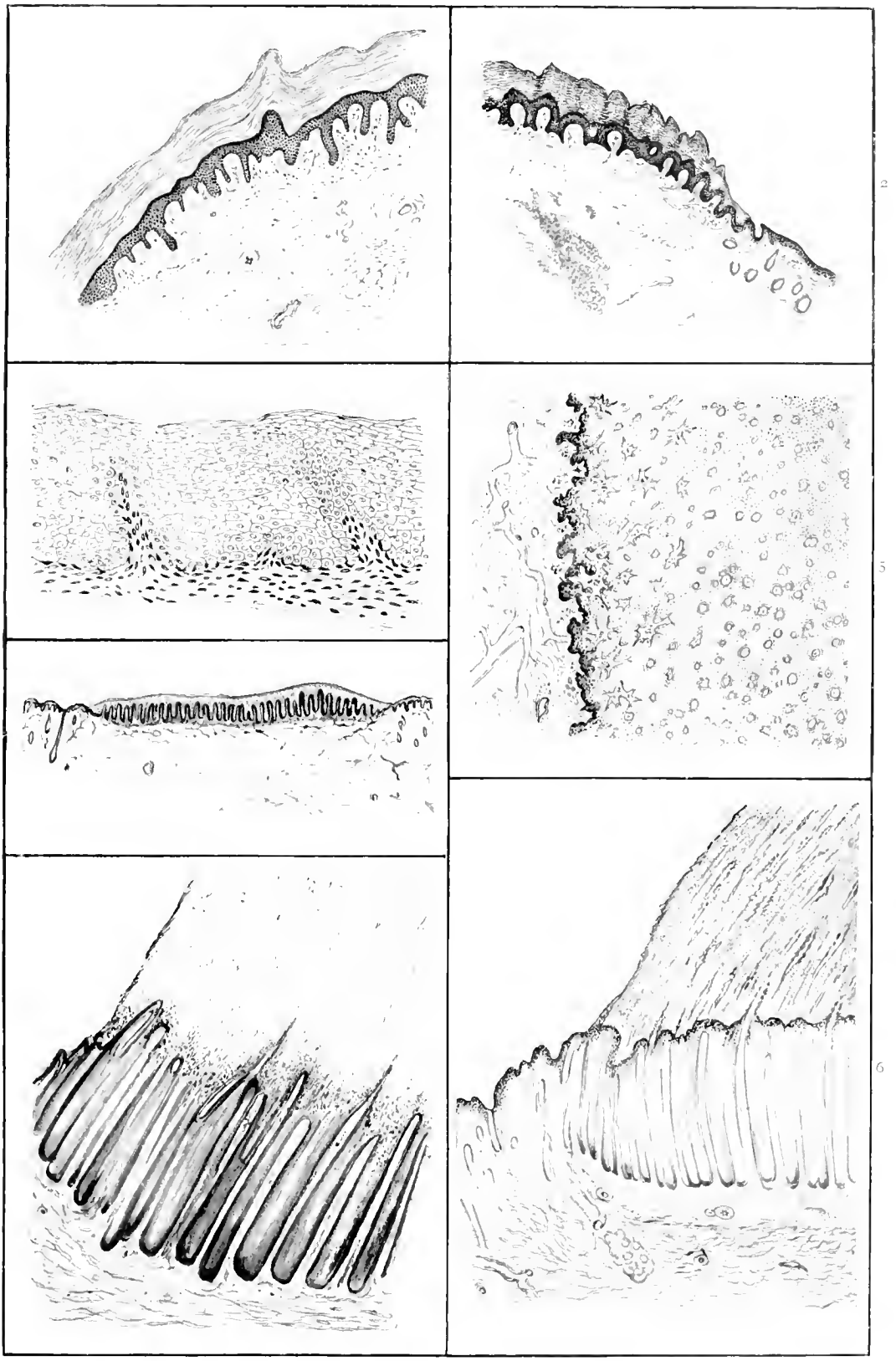
4. Chestnut of Fœtus of Mare, approaching maturity (3 diameters).

5. Transverse Section of Chestnut of Adult horse (12 diameters).

6. Longitudinal Section of Chestnut of Adult Horse (12 diameters).

7. Longitudinal Section of Ergot of Horse (12 diameters).

*** Each section shows the horny covering, the secreting villi, and the soft underlying tissues.



MICROSCOPIC STRUCTURE OF PLANTAR PADS, CHESTNUTS, AND ERGOT

the internal ear, called the Eustachian tube. The guttural pouches do not now appear to have any special function, and to the veterinary surgeon they are a source of anxiety in many cases, as they are liable to become diseased from the lodgment of foreign substances in them. Sometimes they are the seats of purulent deposits, and now and then become distended with air.

Altogether, so far as the horse of domestication is concerned, they might apparently be dispensed with, notwithstanding their value as relics of a long-past order of things.

FOSSIL ANCESTORS OF THE HORSE

The preceding remarks on the special characters of some portions of the horse's structure, and on the presence of organs and parts which have now no obvious use or function, have cleared the way for a brief enquiry into the evolution of the horse. Organs which are now gradually becoming rudimentary and useless must have once formed essential parts of the animal's structure; and in their present state it may be said of them that their existence cannot be satisfactorily accounted for except on the assumption that they were transmitted from remote ancestors in gradually modified forms, becoming less and less definite in character as they became either obstructive or unnecessary to the animal in its different surroundings and new mode of life.

The doctrine of evolution has already been illustrated by reference to the process of generation in the higher and lower forms of life. Changes in the small mass of "undifferentiated (that is, formless and jelly-like) protoplasm" in the human ovum (egg) have been seen to result in the development of a mature human form; and almost identical changes in a microscopic cell in the ovum of other animals have also been referred to.

No hesitation is permissible in respect to the facts of evolution which have been described. Wonderful in truth they are, unbelievable, perhaps, to many, but nevertheless commonplace facts to the man of science, who has had the faculty of wonder obscured and dimmed by incessant repetition of the marvellous in his daily work, and who can no longer take refuge in doubt, because the evidence forces him altogether out of the region of doubt.

Continuing the investigation in the direction of the previous remarks, evidence has now to be produced from the discoveries of geology to justify the assertion that the modern horse had its origin in the remote past in ancestors the history of which can be traced from the earliest beds of the Tertiary formation up to deposits of a comparatively recent date.

In dealing with this part of the subject two courses are open, either to trace the horse from its present condition backwards to the first-discovered hoofed mammal in the lower Eocene, or to begin at the beginning and follow the changes in size and arrangement of his various organs in successive generations of horse-like animals, each series becoming more and more like the horse, until, in the recent deposits, the differences are almost obscured by similarities, and finally vanish altogether. The latter course will probably be the more interesting and intelligible.

It has been well said that the horse is an animal the evolution of which from the Eocene to the Pleistocene may be compared to a chain in which there is scarcely a missing link.

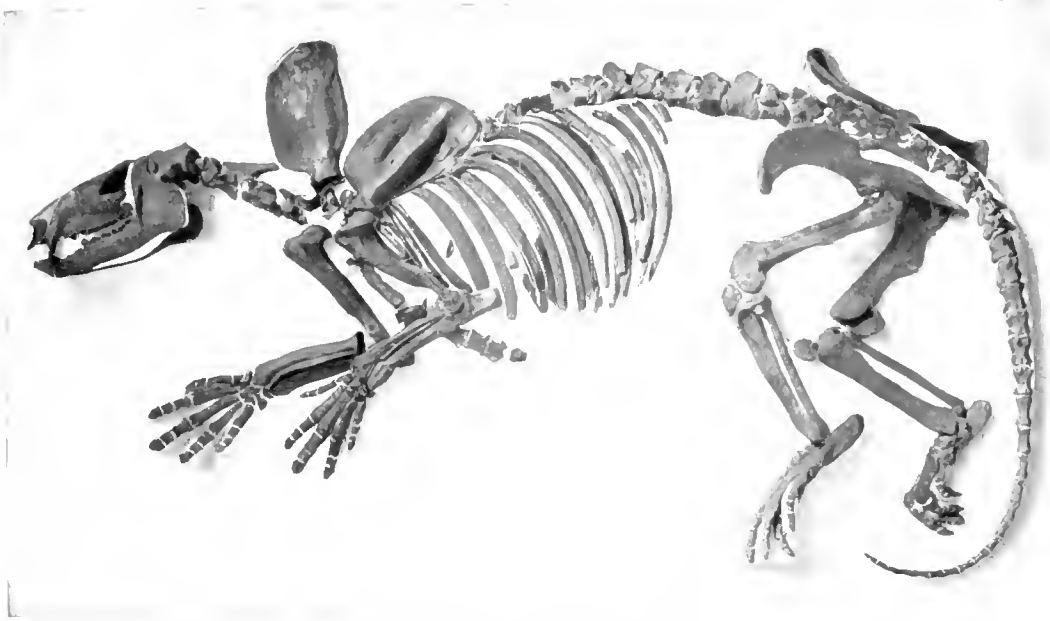
Starting with the earliest hoofed mammal yet discovered, which, though not a direct ancestor of the horse, has certain special characteristics in common with it—the animal known as the Phenacodus deserves notice. The first specimen was dug up by Professor Cope from the Eocene marl on Bear River, Wyoming, and the restored skeleton of the animal is represented in Plate LXX.

The lighter shaded portions of the figure indicate the places where missing portions of bones have necessitated restorations. No important bones are absent, although, as necessarily happens in fossil specimens, some displacement of parts has occurred.

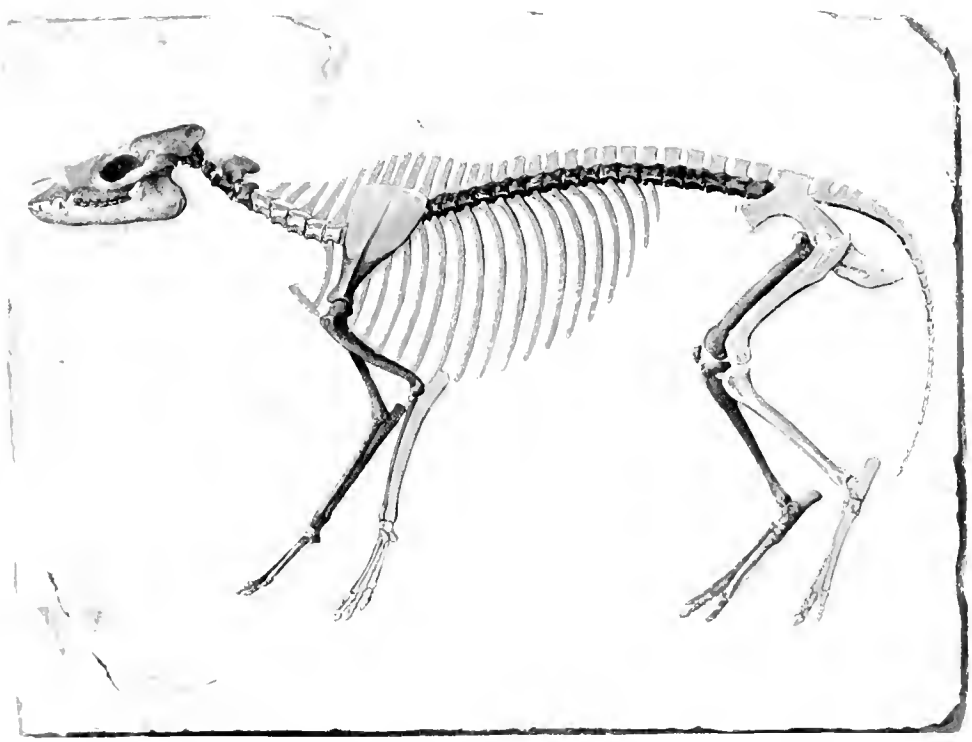
A glance at the skeleton of the Phenacodus will show that it belongs to the perissodactyle or odd-toed mammals, and that the third digit is distinctly larger than the rest. It is not to be understood that the animal here shown is to be taken for the primeval horse, but it has several characteristics in common not only with the horse but also with the rhinoceros and tapir, which lead us to conclude that these animals are all descended from nearly allied ancestors, of which the Phenacodus may be taken as a representative.

In the later Eocene and the formations overlying it the remains of hoofed mammals are found exhibiting remarkable changes in their teeth and in the arrangement of the bones of that part of the extremities which is rightly called the foot, the bones below the joints called the carpus or wrist and tarsus or ankle in man, the knee and hock of the horse (see Plate LXXI). From the five-toed Phenacodus the change to four, three, and then one (with rudimentary splint bones) is seen to have gone on with remarkable regularity, as indicated in the illustrations.

In the Plate the extremities of the limbs have all been drawn to the same scale, so as to show their relative sizes, fig. 1 representing the fore- and hind-feet of the Phenacodus already mentioned—an animal about as large as a fox—whilst fig. 7 represents those of the horse of the present day.



SKELETON OF PHENACODUS



SKELETON OF PROTOROHIPPUS

The worn or exposed surfaces of the upper molar teeth of five of these fossil animals and of the horse are represented in fig. 667; in order that the development from the comparatively simple structure of the tooth of the Hyracotherium to the complicated details of the teeth of the Hipparion and horse may be more readily followed, those figures are drawn of the same size, although in nature there is a gradual increase in size as well as in complexity. Of these examples the first three belong to the brachydont or short-crowned class, of which a side view is given at *a*, fig. 668, whilst the teeth of the Protohippus and Hipparion show an advance towards the state of hypsodont or high-crowned teeth (*b*, fig. 668) which culminates in the horse (*c*, in the same figure).

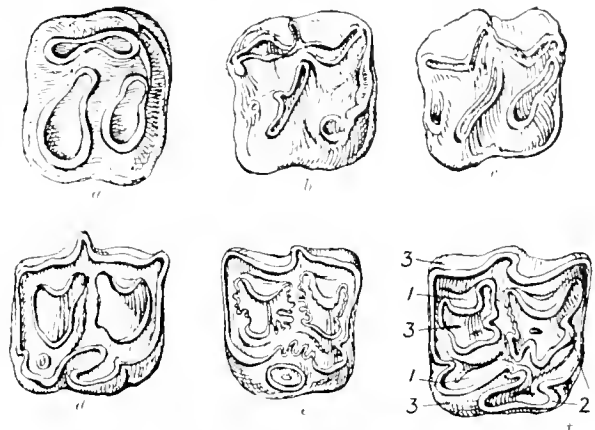


Fig. 667.—Upper Molars of Fossil Ancestors of the Horse

a, Hyracotherium; *b*, Mesohippus; *c*, Anchitherium; *d*, Protohippus; *e*, Hipparion; *f*, Horse — 1, dentine; 2, enamel; 3, crusta petrosa.

Next in chronological order to the Phenacodus mention must be made of the Hyracotherium and the Eohippus, also from the Eocene, which are, so far as is at present known, the earliest direct ancestors of the horse, the former in the Old, the latter in the New World. They may, indeed, be varieties of the same animal, and they are described as being about the size of a fox. In the fore-feet there were four well-developed toes and the rudiment of another, the hind-feet had three toes, as represented in the Protorohippus (fig. 2, Plate LXXI), which marks the next step in the order of development. The change which has taken place in the latter animal, as will be seen by reference to the figure, consists only in the loss of the rudiment of the first digit, leaving second,

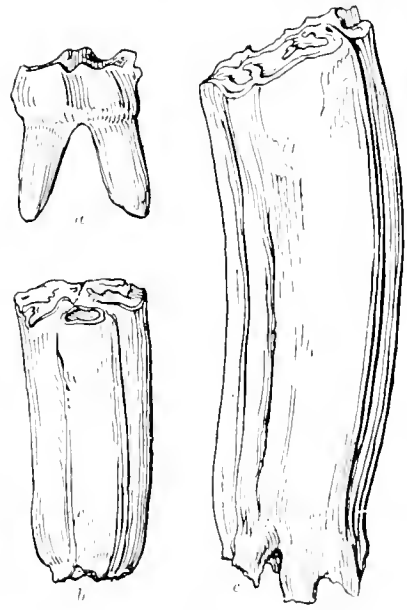


Fig. 668.—Short- and Long-crowned Molar Teeth

a, Anchitherium; *b*, Hipparion; *c*, Horse.

third, fourth, and fifth digits. It will be observed that the third or middle digit is the largest of the four, representing in fact what has previously been termed the one big digit of the horse.

The Protorohippus has a well-developed ulna, a well-developed fibula, and short-crowned grinders of simple pattern.

Comparing its skeleton (Plate LXX) with that of the horse, we see that there is a general correspondence in grace and delicacy of outline in the two animals.

The next drawings (fig. 3, Plate LXXI) represent the fore- and hind-feet of the Mesohippus, from the Lower Miocene immediately succeeding the Eocene in which the Protorohippus was found. In comparing this set of figures with those last described, it will be seen that only three prominent digits remain in both the fore- and hind-feet, the fifth digit

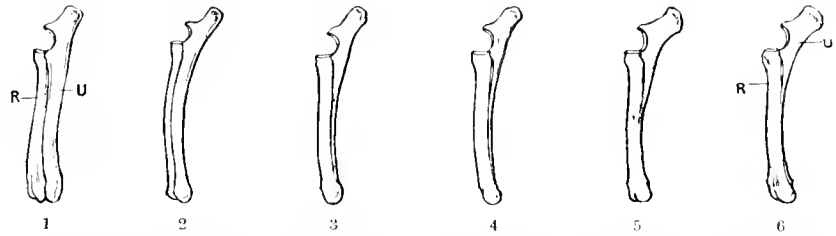


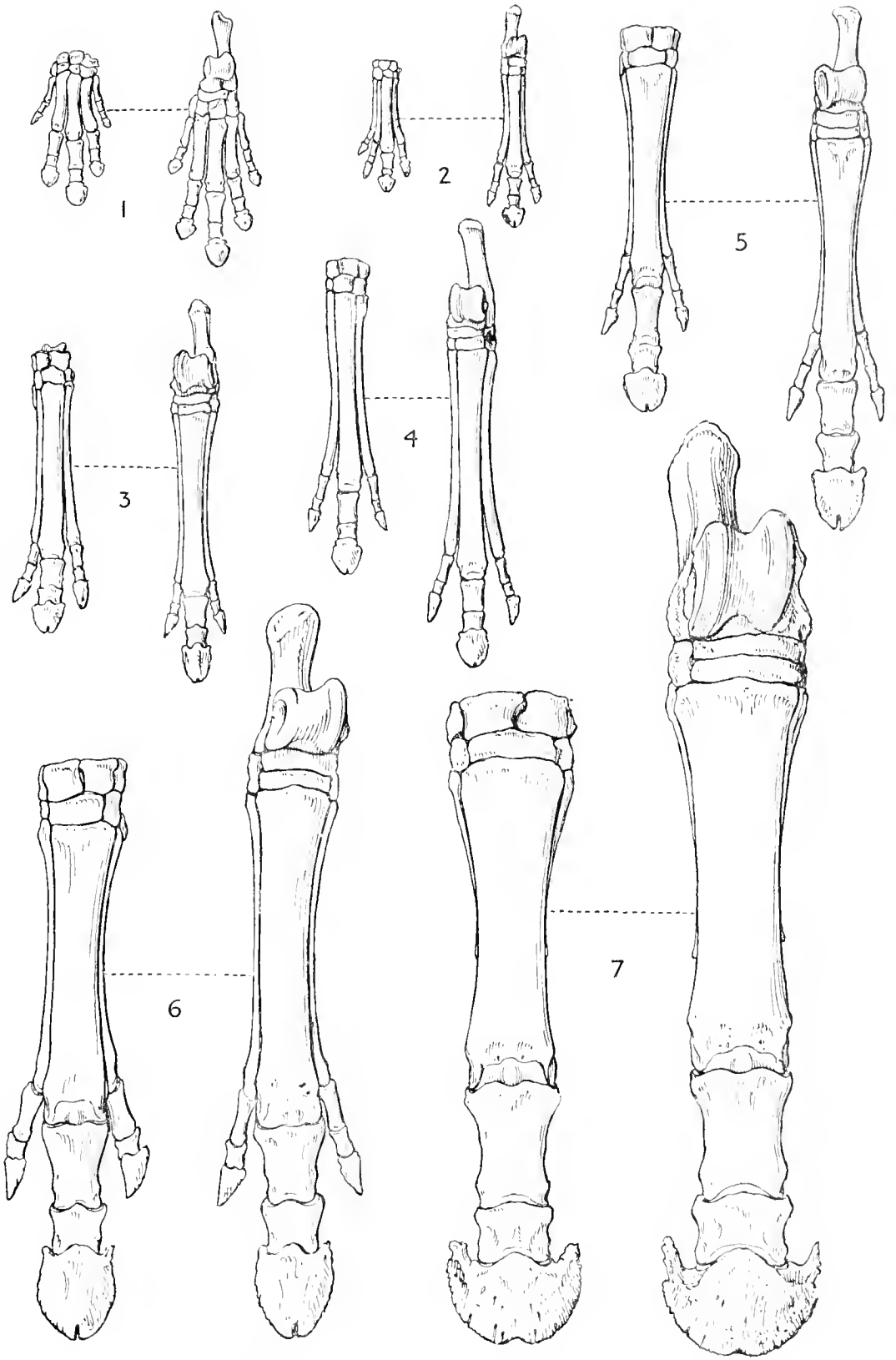
Fig. 669.—Radius (R) and Ulna (U) of Fossil Ancestors of the Horse, showing the gradual diminution in relative size of the ulna (not to scale). 1, Phenacodus; 2, Protorohippus; 3, Mesohippus; 4, Miohippus (Anchitherium); 5, Protohippus; 6, Horse.

being reduced to a very slender rudiment. In this animal the ulna (fig. 669) is well developed, but the fibula has become quite rudimentary; the forms of the molar teeth have not undergone very considerable change.

In the Miohippus, the contemporary of the Anchitherium of Europe, the extremities remain nearly as in the Mesohippus. The ulna has the lower part greatly reduced; the other limb-bones remain nearly the same.

To the Miocene period also belongs the Merychippus, found throughout a large portion of North America, which is remarkable in that in the young condition it has the short-crowned, uncemented teeth of its ancestors, while the adult animal has the long-crowned and cemented teeth of its successors.

Proceeding upwards to the Protohippus and its near relative the European Hipparion from the Lower Pliocene, it appears that the changes chiefly relate to the ulna, which in these animals has decreased considerably in length, only reaching to the middle of the radius. The two



COMPARISON OF THE FORE AND HIND FEET OF THE HORSE
WITH THOSE OF SOME OF ITS ANCESTORS

1. Phenacodus. 2. Protorohippus. 3. Mesohippus. 4. Miohippus and Anchitherium. 5. Protohippus. 6. Hipparion. 7. Horse. (All these figures are drawn to one scale.)

extra toes in the fore- and hind-feet still remain, but they are evidently shrinking in size. The changes in the molar teeth are also very considerable. As will be seen on reference to fig. 668, the teeth are passing from the brachydont or short-crowned to the hypsodont or high-crowned variety, a change which goes on progressively in correspondence with the vanishing of the extra digits. In the upper molars of the Hipparion there is a distinctive feature which is at once recognized by the anatomist, in the presence of an interior column of dentine completely isolated from the rest of the mass, as shown in the section of the upper molar (*e*, fig. 667) close to the bottom, in the form of a white oval spot surrounded by a double line.

There can be no doubt that the Hipparion was remarkably like a horse, though possibly not a direct ancestor. It was somewhat smaller than the Wild Mongolian Horse, of which an illustration is given on Plate LXXIII, and differed from it in the presence of the extra digits, which were, nevertheless, becoming rudimentary. The animal evidently used only the single hoof, the extra toes being some distance off the ground surface. It may be remarked that some of the species of Protohippus are said to have been as large as an ass; this is particularly the case with the European Hipparion.

Proceeding from the Lower Pliocene to the Upper, the Pliohippus is met with, in which the extra digits have become entirely rudimentary, closely approaching in form the splint bones as they are found now in the limbs of the horse. The lower phalanges and the hoofs of the extra digits which were depicted in the Protohippus have entirely vanished. The ulna and the fibula are very much the same as we find them in the horse, the molar teeth are assuming a more equine character.

The next step is to the Pleistocene and recent strata in which the fossil remains of the true horse are found. Some of the fossil types have, however, peculiarities of their own, such as the large nasal development of the Hippidium from South America, figured in Plate LXXII. The extra toes, the ulna, and the fibula are now in their present rudimentary form, the molar teeth show the characteristic hypsodont type, and the anterior separate column of dentine has entirely disappeared in the upper molars. The history of the evolution of the horse, so far as the evidence furnished by geological researches is available, is thus complete, and surely a more connected and consistent story was never constructed.

According to promise, the chain of events in the descent of *Equus caballus* has been traced along its many links from the most distant, the Eohippus of the Lower Eocene, to the modern horse found in recent geological deposits.

For the rest of the story of the horse no further demand will be made on the reader's patience or imagination. An active or perhaps a despairing mind may indulge in gloomy anticipations of a time when the *Equus caballus*, no longer necessary for man, will gradually disappear, and be known to future enquirers only through the science of paleontology.

SKULLS OF SOME ANCESTORS OF THE HORSE

1. Protorohippus venticolus.

2. Mesohippus Bairdi.

3. Hipparion gracilis.

4. Onohippidium Munizi (an extinct South American horse).

5. Arab Horse.

A is a cavity for a face gland, and is very marked in Hipparion (3) and Onohippidium (4), while a vestige of it remains in the Arab horse (5). It is absent from some breeds of living horses.

B is the remarkably long nasal slit which is a very noticeable feature of Onohippidium (4).

SKULLS OF SOME ANCESTORS OF THE HORSE

THE HISTORY OF THE HORSE

SECTION XV.—THE HISTORY OF THE HORSE

HORSES OF THE PAST

Mention of the horse's existence is to be found in Chinese tradition, which records that during the reign of Hwang-te, who lived before the flood, "Chariots, horses, and bullocks began to be used", and that the same emperor extricated his army "when bewildered in a mist" through the agency of a magnetic pole attached to his chariot, "which always pointed to the south".

The ancient Chinese work known as the Shoo-King speaks of Yaou, who lived before and after the flood, as riding in a crimson chariot drawn by white horses; and Yu, the person employed by Yaou in perfecting the great work of removing the flood and restoring order to the empire, thus narrates how he accomplished the task: "The deluge rose high and spread wide as the spacious vault of heaven, buried hills and covered mountains with its waters, into which the common people, astonished to stupefaction, sank. I travelled on dry land in a chariot, on water in a boat, in miry places on a sledge, and climbed the sides of hills by means of spikes in my shoes. I went from mountain to mountain felling trees, fed the people on raw food, formed a passage for the waters of the sea on every part of the empire by cutting nine distinct beds and preparing channels to conduct them to the rivers. The waters having subsided, I taught the people to plough and sow, who, while the devastating effects of the flood continued, were constrained to eat uncooked food, and in this way the people were fed, and 10,000 provinces restored to order and prosperity" (Kidd's *China*).

The quotations tend to prove that the horse had been subjected to domestication, had been used for purposes of pageants and of war, before the flood, and had assisted the Chinese in clearing the inundated provinces of the waters that brought about the deluge 2348 years B.C. Chinese tradition may be considered of too legendary a nature to be worthy of belief. The criticisms of the past tend to prove that this was the general opinion of the learned world, but during the nineteenth century geological research has opened our eyes by demonstrating the vast antiquity of the earth and

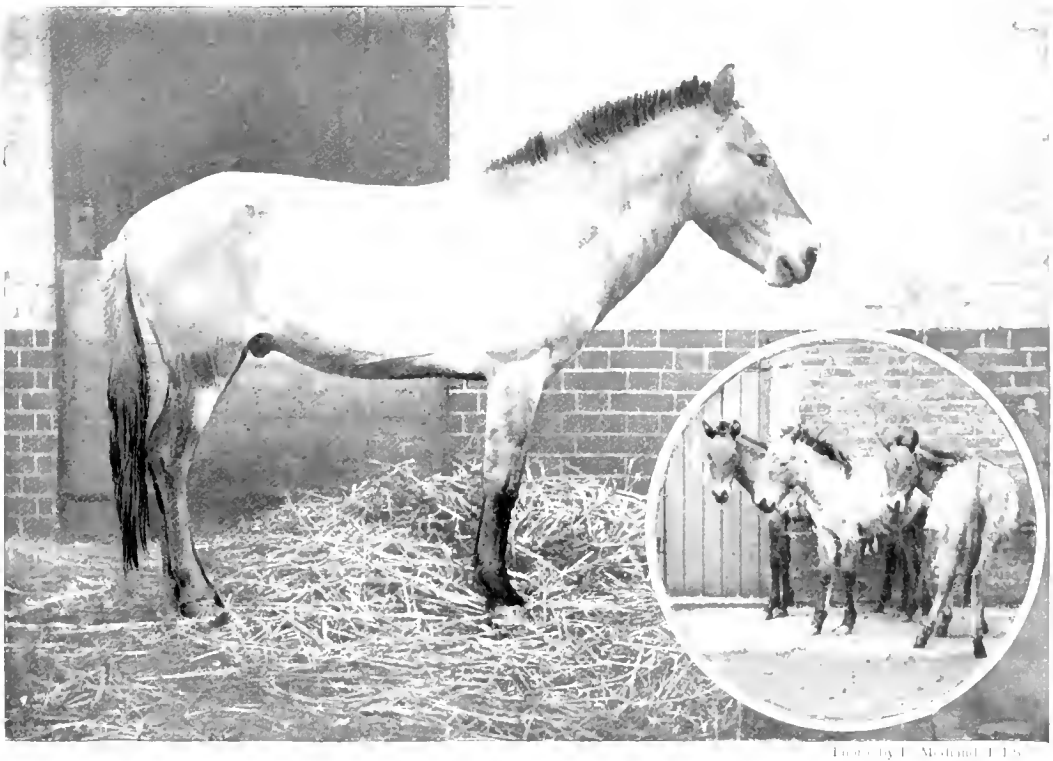
the existence of man on it during thousands of years before the time of Adam, and as such is the case there is not so much difficulty in believing the Chinese tradition of their 75,000 years of national existence. If, therefore, it has been proved that man inhabited the globe at this early period—75,000 years ago,—we can easily understand that the human family has descended from ancestors of pre-Adamic origin, and that the tradition of the vast antiquity of the Chinese race, and of the subjugation of the horse during the antediluvian period, is more worthy of credence than the authors who wrote during the eighteenth century suspected. It must, however, be admitted that legends cannot be received as authentic records of the past, neither are the statements handed down to us in ancient history always incapable of refutation. Sometimes they are fables composed after the manner of Plato, but always under the influence of religious sentiment, and in this particular Arabian literature is conspicuous. For instance, we read: "When Allah willed to create the horse, he said to the south wind, 'Condense thyself; I will that a creature should proceed from thee'. Then came the angel Gabriel and took a handful of this matter and presented it to Allah, who formed of it a dark-bay and a dark-chestnut horse." It is also related by many Arabian historians "that after the time of Adam the horse, like many other animals, lived in a wild state, and was first subjugated by Ishmael, the son of Abraham; but that the horses trained by him lost much of their purity, excepting one stock, whose nobleness was preserved by Solomon, the son of David". There is a tradition that some Arabs of the Azed tribe went to Jerusalem to congratulate Solomon on his marriage with the Queen of Sheba. Having fulfilled their mission, they addressed him thus: "O, Prophet of Allah, our country is far distant, and our provisions are exhausted; thou art a great king, bestow upon us wherewith to take us home". Solomon thereupon gave orders to bring from his stables a magnificent stallion, descended from the Ishmael stock, and then dismissed them with these words: "Behold the provisions I bestow upon you for your journey. When hunger assails you, gather fuel, light a fire, place your best rider on this horse, and arm him with a stout lance. Hardly will you have collected your wood and kindled your flame when you will see him return with the produce of successful chase. Go, and may Allah cover you with His blessing." The Azed took their departure. At their first halt they did as Solomon had prescribed, and neither zebra, gazelle, nor ostrich could escape them. Thus enlightened as to the value of the animal presented to them by the son of David, these Arabs on their return home devoted him to foal-getting, and by carefully selecting dams at length obtained the breed to which, out of gratitude, they gave the name of Zad-el-Rakeb—the support of the horseman. This is the

stock whose high renown spread at a later period through the whole world.

The importance of the Eastern horse no horseman will dispute, and the investigation of equine pedigrees will show how largely the Arab horse has contributed to the perfection of almost every breed of horse in existence, which has been effected by the impression he made upon indigenous stock.

It is thought that the use of the ass and the camel preceded that of the horse. Such might have been the case, but we must remember that during the early historic period these animals were used for different purposes, the ass and the camel to carry burdens—namely, tents and their furniture. When Jacob took his departure from Laban, his goods, wives, and children were placed on the backs of camels, and his sons conveyed the corn they obtained from Egypt on asses; yet at the same time Jacob and his sons recognized that horses possessed qualities that rendered them valuable, for we read: "They brought their cattle unto Joseph, and Joseph gave them bread in exchange for horses and for the flocks, and the cattle of the herds", &c. The pastoral life which Jacob and his sons enjoyed did not necessitate the use of the spirited horse, which in early times was employed almost exclusively for war, and whose hoofs, previously to the discovery of the art of shoeing, would have worn down to the quick during those long journeys which the ass and the camel were capable of performing with impunity. But the nervous temperament, showy action, and activity of movement marked the horse out as a likely assistant in battle, and as a conspicuous feature at pageants; and thus we learn that when Joseph carried his father's body to Canaan, he "had with him a large company of chariots and horsemen", which held a conspicuous position in the funeral procession. This is the first time the Scripture mentions the subjugation of the horse, but there is little doubt that he had been employed by the Egyptians long before this period, and for many years afterwards the breeding of horses was encouraged. This resulted in the production of a fine stock, which Pharaoh was able to select from when he pursued the Israelites across the Red Sea, with "six hundred chosen chariots, and all the chariots of Egypt". But before this period communities of men had collected together to form nations. About the year 2217 B.C. Nimrod is supposed to have founded the Babylonian Empire and Assur the Assyrian monarchy, and these states, according to Ctesias, had studied science and art, fashioned implements of war, yoked horses to the chariot, and had trained the charger to undergo the fatigues of battle, before Moses was born (1571 B.C.). Although such was the case, history does not much assist us in determining the class of horse that was employed during these periods, nor does it inform us whether the horse was found wild in

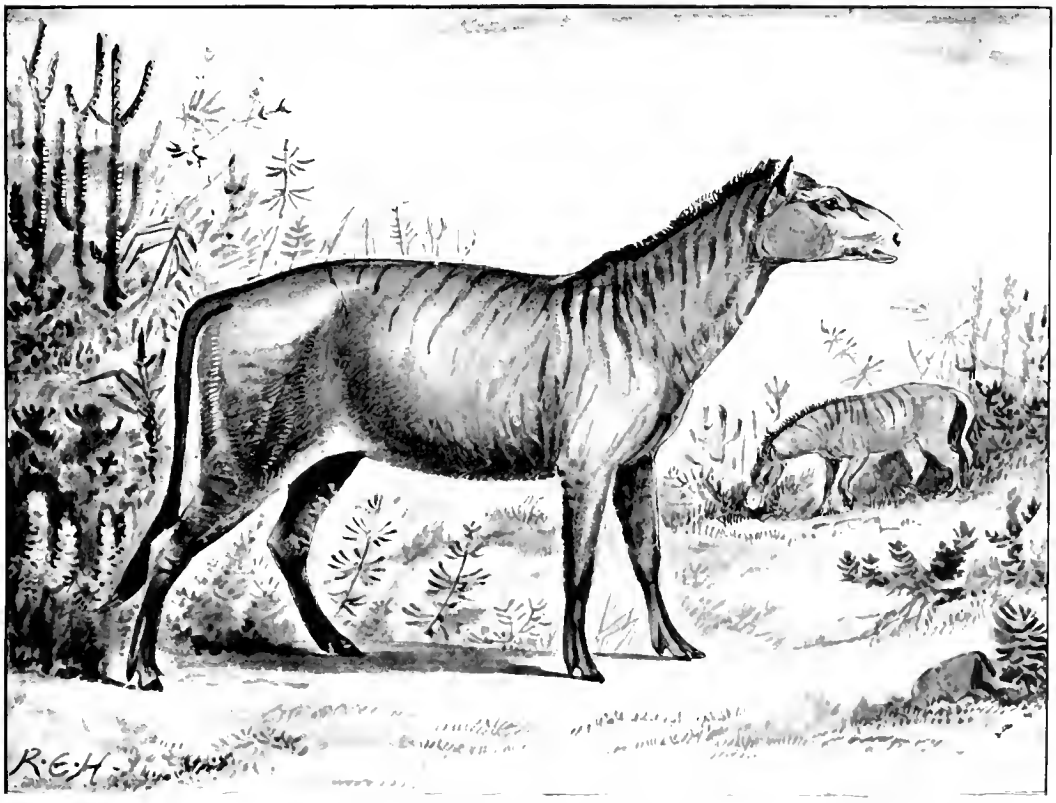
these localities, or was imported from China or from other distant lands in the East; nor do we know whether horses emanated from one centre or many, nor whether they were distributed over Asia, Africa, and Europe at one and the same time, thus forming distinct though distant groups of equine communities from which by frequent intercourse the various breeds of horses have been propagated. At the same time it must be admitted that the early accounts given of the horse's existence are somewhat legendary, and it is not until after consulting the Scriptures that we receive any authentic information on this vexed subject, and this too only of a very fragmentary nature. The beautiful description of the war-horse given us by Job proves that the horse was very early appreciated by Eastern peoples, and in no language have his merits been painted with such force and enthusiasm: "Hast thou given the horse strength? hast thou clothed his neck with thunder? Canst thou make him afraid as a grasshopper? the glory of his nostrils is terrible. He paweth in the valley, and rejoiceth in his strength: he goeth on to meet the armed men. He mocketh at fear, and is not affrighted; neither turneth he back from the sword. The quiver rattleth against him, the glittering spear and the shield. He swalloweth the ground with fierceness and rage; neither believeth he that it is the sound of the trumpet. He saith among the trumpets, Ha, ha! and he smelleth the battle afar off, the thunder of the captains, and the shouting." Although it is said that the Jews did not make much use of cavalry in battle, owing, perhaps, to the mountainous condition of the country, we learn that Solomon imported both chariots and horses from Egypt, and kept a vast number of them—40,000 stalls for his chariot horses, 12,000 horses for his cavalry, and 1400 chariots of war,—and these, we are told, were used more for purposes of display than of war. Such may have been the case, and the taunting message sent by Rabshakeh to Hezekiah, that if he should send him 2000 horses he would not be able to put 2000 riders on them, tends to confirm this opinion; but the Canaanites, with whom the Israelites were constantly at war, possessed a vast number of them, and the Philistines, we read, marched against Saul with 30,000 horsemen and chariots. Other nations —the Egyptians and the Greeks—relied much upon the support of horses both in attack and in retreat, so that in Africa, in Asia, and in Europe the distribution of the equine race had been commenced early. As civilization advanced, the demand for horses increased, and the extensive propagation of them became a necessity. Moreover, wars between nations caused them to be dispersed throughout the various regions of the then known world, where, by intermingling with indigenous breeds, new types were produced.



From a photograph by F. Meyrowitz, F.Z.S.

PRJEVALSKY'S MONGOLIAN WILD HORSE

The small inset shows a group in their original condition



RESTORATION OF THE FOUR-TOED ANCESTOR OF THE HORSE

Protorohippus venticolus

THE GRECIAN HORSE

The Greeks, like the Jews, no doubt derived their knowledge of the horse from the Egyptians, but neither Egyptians nor Jews have handed down to us any authentic information relative to the cultivation of horses, a subject with which Grecian literature abounds. Consequently it is from Greek authors that our primary knowledge of equine lore must be obtained, although previous to this period the Babylonian, the Assyrian, and the Egyptian empires flourished, and the ancient monuments discovered in these countries prove that the horse had not been used for agricultural or domestic purposes, but that his services had been confined to the chase, to pageants, and to war. Traditions, poems, and myths constitute among ancient nations part of their historical resources, and Homer, Hesiod, and other authors have handed down to us most valuable information relative to the manners, customs, and warlike pursuits of the ancient Greeks. Homer describes the various labours of farming, ploughing with oxen and mules, sowing, reaping, and treading out corn by oxen on the threshing floor, and also describes the many various duties of the herdsman, but we fail to discover that the horse had at this period been employed for agricultural purposes. During the Trojan war cavalry did not form a branch of Grecian military organization, but chariots and horses were conveyed in the ships that sailed to Troy at the traditional date of 1194 to 1184 B.C. The united Grecian princes, who undertook this famous expedition under the command of Agamemnon, sailed, according to Homer, with 1186 ships and 100,000 men, and the ships conveyed horses and chariots in which they fought in battle; but no mention is made of cavalry horses, and consequently it may be inferred that at this time they had not been devoted to this service.

According to Greek legend Chiron the Thessalian, supposed to have been an Egyptian, was the first person who mounted the horse; and there is no doubt that the unfamiliar appearance of a man on horseback gave rise to the fable of the Centaurs, a race of beings half-man, half-horse, said to have anciently inhabited Thessaly. From the famous war said to have been carried on between the Lapithæ and the Centaurs we may conclude that at a date as early as 960 B.C. the Thessalians used cavalry in war. Chariots and horsemen were known to several nations before this period—the Babylonians, the Assyrians, and the Egyptians had made use of them,—but the Greeks claim that Erichthonius, who was lame, was the first inventor of a carriage, which he built for his own personal convenience, and of horse and chariot racing, which was first inaugurated

at the Panathenæa, the festival held in honour of Minerva, 1506 B.C. But the horse had been ridden long before this date by Babylonians, by Assyrians, and by Egyptians, and also by the descendants of Ishmael, if we place any faith in tradition. If Chiron was the first to mount a Grecian horse, there is every reason to believe that the Arabians for ages previously had been accomplished equestrians.

Up to this date the demand for horses had been created by the chase, by pageants, and by war, but the world had not to grow much older before an incentive occurred in the inauguration of the Olympic games. These are said to have been first celebrated in Greece in 1453 B.C., but it was not till 884 B.C., when Iphitus, and after him Chorœbus, 776 B.C., renewed these games, that they became a world-famed national institution. The horse did not, however, make his appearance in the hippodrome until the 23rd Olympiad, 680 B.C., when he was ridden, and it was not until the 25th Olympiad that he was yoked to the chariot, and his speed and power of endurance were tested in harness, after which chariot-racing became a dominant pastime of the Greeks. The Olympic games comprised horse, chariot, and man racing, leaping, throwing the discus, wrestling, and boxing, and for these sports separate areas were set apart: the stadium for the contests in running and wrestling, the hippodrome for horse and chariot racing, &c. Amongst all these games horse-racing and chariot-racing were the most popular, and they embraced various forms of sport: the chariot race with mules, with mares (described by Lausanias), the chariot race with matured horses, with four foals, and with two foals, and there was also a horse race, in which boys rode.

The hippodrome of Greece possessed the same influence as the British turf now exercises in the production of good horses. For performance at these games fleet horses were imported from all parts of the world, studs were established, training-stables built, and running-tracks laid down with as much eagerness by the ancient Greek as by the British owner of race-horses at the present day, and consequently Greece, from its earliest days, became conspicuous as a horse-breeding country. Tacitus describes the celebrated breed of horses that existed at Argolis, and the surrounding country is mentioned by Homer as forming an extensive grazing-ground favourable to the propagation and development of horses. Diodorus Siculus states that in ancient times Macedonia "abounded in horses above all countries in Greece", and that at the royal stud in Pella 300 stallions and 30,000 mares were kept. Strabo also informs us that the Cappadocians paid an annual tribute to the Persians of "1500 horses, 2000 mules, and 50,000 sheep".

Yet, although Greece was a large horse-rearing country, and horses

were extensively used in dangerous contests at the hippodrome, she seems to have used them only sparingly on the day of battle, and then only when yoked to chariots; but cavalry, which formed a most important military force of the Persians and other neighbouring nations, was by the Greeks long almost entirely neglected.

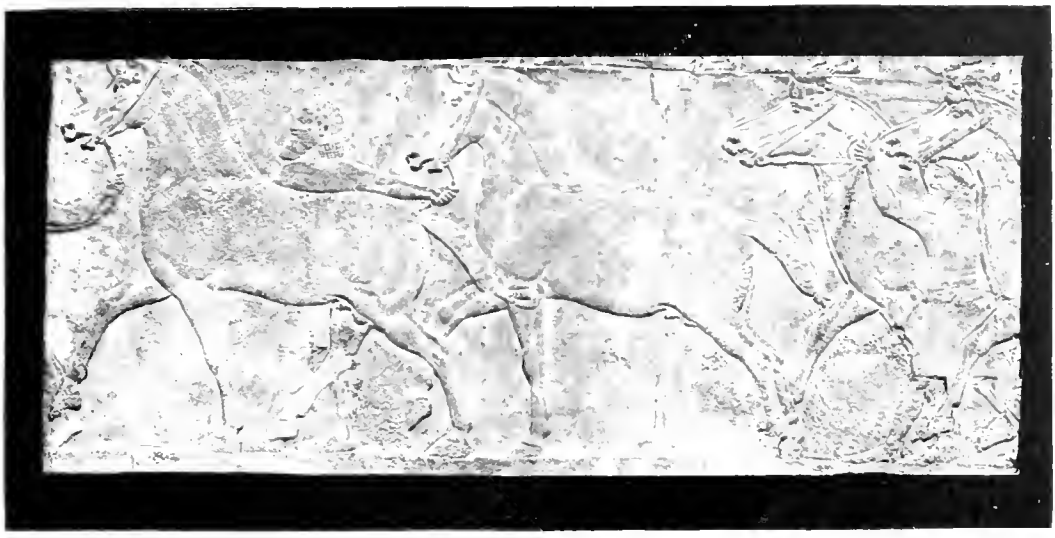
It appears, according to Herodotus, that up to the year 490 B.C. the Greeks possessed no cavalry, and at the beginning of the Peloponnesian war, 431 B.C., it only amounted to 1200 strong, out of which number 200 were hired Scythian bowmen. And even down to the time of Demosthenes this corps was not numerically increased, but it was the duty of the two hipparchs who commanded this force to see that it was kept up to its full force of 1000.

At the battle of Marathon (B.C. 490) the Greeks used no cavalry, while the Persian army comprised 100,000 foot and 10,000 cavalry. It seems difficult to understand why the Greeks did not employ cavalry in battle, surrounded as they were by nations who made great use of this branch of the service in times of war. Yet, unaided by cavalry, they routed the Persians at Marathon, and on other occasions they had beaten their enemies without the aid of this auxiliary, and instances had occurred where chariots had caused confusion and disaster. Xerxes' army which passed over the Hellespont, according to Herodotus consisted of infantry 170 myriads, of cavalry 8 myriads, exclusive of chariots and camels. In this expedition fifty-six different nations took part, the infantry of which appears to have been little better than a rabble, whose vast numbers, crowded together on the battle-field, interfered with the action of the cavalry and put them into confusion. Marathon, Platæa, and Mycale are witnesses of like dilemmas. The war-chariots could not act upon uneven and broken ground, and thus, being rendered incapable of acting, became dangerous impediments. Another reason why the Greeks did not employ cavalry might have been the rough and stony ground over which their armies had to march, over roads whose surfaces wore down their horses' hoofs so low as to cause them to become sore and almost incapable of locomotion. For short journeys and performance in the hippodrome the tracks were laid down with soft material, so that horses could run over their 4-mile courses with impunity; but over hard roads during arduous and prolonged marches their hoof horn constantly wore down to the quick, when the sufferers had to be left in the rear. It is evident that although the horse was not, in the early part of Grecian history, used extensively as a war-horse, he was highly esteemed as a hunter, for pageants, for racing in the hippodrome, and for purposes of pleasure, and the pens of the greatest-minded Greeks were devoted to

the narration of his qualifications and the means to be adopted so as to protect him from disease and injury and to preserve him in health.

The writings of the Athenian general and historian Xenophon prove to what a high degree of perfection the horse at this day had arrived, and the attention he required to keep him in sound condition. The retreat of the 10,000 Greeks, after their defeat by the Persians under Cyrus, 401 B.C., shows that in his day Grecian cavalry had become an important branch of their military organization. At this period Xenophon had the same difficulties to contend with as previous horse-owners had complained of, namely the wearing away of the horses' hoofs during long and protracted journeys over rough and stony roads, and for this reason he prescribes treatment calculated to harden the unshod hoof, by causing horses to stand upon rough stone stable-floors, and upon similarly constructed pavement when groomed outside the stable. He adds: "Those horses whose hoofs are hardened with exercise will be as superior on rough ground to those which are not habituated to it, as persons who are sound in their limbs to those who are lame". Xenophon also has described the points of a good horse, and the breeding, rearing, and treatment of young horses; from which it is evident that at this period horses were used not only for the sports of the hippodrome and for hunting, but also for war; but as yet they had not been used as beasts of burden, neither had they been yoked to the plough nor engaged in farming operations—the mule, the camel, and the ox performed these services.

Although Greek authors have described the capacities in which horses were employed, they have not given us pictures of the various equine breeds which it is natural to imagine surrounded them. Xenophon certainly has described the horse of his day, and the friezes of the Parthenon now at the British Museum (Plate LXXIV) give us an idea of one equine type, but not of the many which must have existed during the flourishing days of ancient Greece. At the same time the Grecian horse might have been of one type—the one linked to the chariot might have been of the same breed as the one on which the trooper rode in battle,—and if such was the case it must be accounted for on the supposition that the Grecian stock was of Arabian descent, for the statuary of horses discovered in the ruins of Nineveh gives portraitures of these animals very similar to the Grecian horses represented in the Elgin marbles, and consequently both might have originated from a common stock and birthplace. Buffon considered that Arabia was the centre from which the horse sprang, and this has been the generally accepted opinion. This subject will be recurred to when writing on Arabian horses; let it suffice for the present to give the opinion of an eminent authority "It is generally supposed from the omission of all mention of horses while



ASSYRIAN HORSES

From the Palace of Assur-bani-pal, Nineveh

GREEK HORSES

From the Parthenon Frieze

the Israelites were in Arabia that this country, which has since become so celebrated for them, was at that time entirely without them. The proof is, however, of an entirely negative character, though I confess that it is as good as any of that nature can well be. Indeed 600 years later Arabia could not in any way have been celebrated for her horses, for Solomon, whilst he resorted to her for silver and gold, mounted his cavalry from Egypt. Yet the latter country could scarcely have been the native land of the horse, not possessing the extensive plains which are so peculiarly suited to his existence in a wild state, and it is considered probable that he was introduced from the central regions of Africa, which are undoubtedly the native plains of the quagga, the zebra, and some other congeners of the horse, but where, curiously enough, he is not found in a wild state." —Stonehenge on the Horse.

These arguments are based on the supposition that the various equine races emanated from one common stock, if not from one pair. But if we accept the theory that different varieties originated in several regions of the world, whether by creation or by evolution, it can easily be understood that horses of more than one type existed at one and the same time, and inhabited countries situated at long distances one from the other, each country possessing a distinct stock of its own, upon which horses imported from Africa or Arabia, by intermingling, were sure to produce a good cross. Tradition tells us, and history lends its authority to the assertion, that in the earliest ages of the world Africa was conspicuous for a celebrated breed of horses. No doubt the Sahara was the birthplace of the barb, which in the past gave as excellent impressions to the equine stock of ancient nations as its descendants, the Oriental horses of the Stuart epoch, did in the production of the British thoroughbred. It is possible that the barb and the arab may have descended from the same stock, but they may have been distinct breeds; and this seems most likely to have been the case, as the Assyrians possessed horses, chariots, and horsemen at the same time as the Egyptians.

THE HORSES OF ROME

The Romans appear not to have been an equestrian nation, though they are said to have possessed a body of cavalry soon after the founding of the city by Romulus (752 B.C.). It is well known that they relied almost entirely on their infantry in the day of battle, and that their horse soldiers were in most instances no match against the cavalry of their enemies. They could not withstand the onslaught of the Numidian and Parthian horse, and had to succumb to the cavalry of Macedonia and Epirus. We

consequently learn that Rome relied more upon mercenary cavalry than upon her own, and in the time of Cæsar this force consisted of auxiliary corps composed of Numidians, Thracians, Spaniards, and Germans commanded by Roman officers (*Præfecti equitum*). "The Roman cavalry had disappeared before Marius: its last mention is in the Spanish campaign of 140 B.C., and after the Jugurthan war it vanished entirely. Even the Italian cavalry had been for long unable to cope with the enemies of Rome; it had been defeated by Hannibal in Italy, and Scipio only won Zama by the cavalry of Massinissa. It vanished completely in the social war, and after that foreign troops—Gauls, Spaniards, Thracians, and Africans—were taken into the service in larger numbers than before." It will be unnecessary to refer further to the native-bred equine trooper of Rome.

Yet although the native Roman horse was not a conspicuous charger, he was a beast of burden, and in this capacity became most useful to the postal service which was instituted for the purpose of transmitting letters, parcels, and baggage of every kind throughout the vast Roman empire. This important state department required for the execution of its duties several kinds of animals, namely horses, mules, asses, and oxen, which were ridden or employed in drawing vehicles laden with light or heavy goods and in the delivering of letters, parcels, &c., at their respective destinations. This service was divided into two branches, the one for light and the other for heavy traffic. Yet had it not been for the existence of the splendid roads throughout the Roman territories, which connected the remotest parts of the empire with Rome, the postal service never could have become so important an institution.

At this time a vast road traffic necessitated the employment of thousands of horses, the demand for which must have been great and have operated as an incentive to the production of the general utility horse. This type of horse was in most instances the descendant of native stock, and was the class of animal adapted for heavy vehicular traffic; but he could not perform with success in the arena, neither was he good enough for a charger. At circus exhibitions horses obtained from foreign sources, especially from Asia, always proved themselves to be *facile principes*.

The *Circus Publicus* caused the employment of thousands of horses, and consequently created a demand which was responded to by the importation and extensive propagation of horses; but a greater incentive even than this far-reaching road traffic existed in the amphitheatre, which represented the race-course, where chariot and horse racing formed the leading sport of patrician Rome.

The games which took place in the circus were, so it is said, instituted by Romulus. They consisted in wrestling, running, fighting, horse-racing,

and chariot-racing. For the latter pastime swift horses from all parts of the world were sought for by men who devoted their time and money to the promotion of this sport.

The equestrian exercises in the circus, for which the Romans were so famous, were no doubt introduced from Greece, and the best equine performers were imported from foreign sources—from Spain, Sicily, Greece, and in later times from Cappadocia. The horses intended for this sport were not broken in until three years old, and were not raced until the completion of their fifth year; and in consequence of this wise treatment we find that such horses were during several years winners of many races. A horse which was a winner of 100 races was called *Centenarius*. In the inscription of Diocles a horse named Tuscus is mentioned as the winner of 429 races, and others were even more successful. The drivers of chariots were originally of a low class and often slaves; yet when they won races the slaves received their freedom, and the winners generally were handsomely rewarded.

Under the Empire, especially after Caligula and Nero had mounted the chariot, the patricians condescended to contend in the arena, and many descriptions of races have been handed down to us which reveal how great was the rivalry between families and factions in order to gain victories at the circus. Horse-racing and chariot-racing in the Roman circus were conducted very much upon the same principles as horse-racing at the present day; advertisements of race-meetings placarded in large letters were exposed in conspicuous places, as the discoveries at Pompeii prove; cards of the races, on which the names of the starters, riders, and drivers appeared, were sold; fortunes were won and lost; betting enslaved patrician and plebeian alike; intrigue and villainy corrupted the public mind, bribes secured a winner, poison put an end to the career of a dangerous favourite, and Caligula is said to have removed by iniquitous means the best drivers of his rivals' horses. This brief description is sufficient to prove how great must have been the incentive to the production of first-class horses, and that such was the case we learn from the fact that Marius had a stud farm where he "bred Moorish horses for the circus" "In 1878, in a village of Oued Atmenia, in Algeria, some elaborate mosaic pavements were found in the villa of the pro-consul of Africa under Honorius, who appears to have been a great breeder of horses for the circus. Perspective views of the training stables are represented on those mosaics, and other pictures show the racers in their stalls clothed from head to foot"—*Dictionary of Grecian and Roman Antiquities*.

The horses bred on Roman soil for performing at the circus were of foreign extraction. The native horse had proved himself inferior to the horses of Persia and Greece on the battle-field, and in the arena he had

given way to the importations from Spain and Cappadocia. All the countries named, it will be seen, owed their excellence to one source, to the horses of Africa, which had no rival until the descendants of the Barb and Arab, represented in the British thoroughbred, became kings of the equine race. Cabs also represented another institution which caused horses to be in demand. The Roman cab was a two-wheeled vehicle capable of seating two persons besides the driver, and was drawn by one or two horses or mules. These vehicles were stationed about Rome, and were kept for hire on the great roads. Cicero mentions a case where a messenger travelled 56 miles in ten hours over these highways. From the foregoing we learn the various uses in which the horses of Rome had been employed, and although *the Circus Publicus* and *cisia* (cabs) demanded the assistance of strong horses, we find that the Latin authors who wrote conjointly on the tillage of the soil and the treatment of animals never mention the horse as having been engaged in agricultural operations. Virgil, in his *Georgics*, discourses about trees and crops, but tells more about the cultivation of bees than any other animal, and devotes only a very small space to the consideration of equine lore. Vegetius (a late Latin writer) gives descriptions of the various breeds of horses that existed in Italy, and indicates the different kinds of labour they had to perform, but the farm-horse is not included in his catalogue. For the circus, he writes: "The Spanish horse excels all others, even the Sicilian, although African horses are the swiftest of any. For the saddle above all the Persian horses are the easiest in carriage and most soft in step, afterwards come the Armenian, nor should the horses of Sicily and Epirus be despised, though not equal to them in deportment nor in form." For chariots he recommends the Cappadocian horse; for war that of the Huns, which breed he thus describes: "The horse of the Huns is known from all other breeds by the great curving outward of the front of the head, by his prominent eyes, small nostrils, broad jaws, stiff neck, mane reaching to the knees, wide ribs which stand out, hollow back, tail copious with long and curly hairs, stout shanks, small fetlocks, large and spreading hoofs, hollow flanks, angular body with projecting points of bone, length which exceeds his height, belly when it is empty and when the horse is out of condition hanging low, bones everywhere large, agreeable leanness of appearance which contributes to him rather a grace than a deformity, gentle and cautious temper, and by his patient endurance of the wounds and casualties of war". For the saddle, owing to their easy gait, he prefers Persian horses, which "in stature and fashion are much the same as other kinds, but the great difference consists in their walking with a grace peculiar to them, for their steps are very short and frequent, and this makes riding delightful; nor can they be taught it by

art, but it appears to be the pure gift of nature. With the Persian horse it is ascertained that his step is more pleasant in proportion as it is shorter; in long journeys his patience is very enduring. His temper is haughty; unless he is subdued by continued exercise, he is apt to be vicious and stubborn; nevertheless he is sensible and intelligent, and, what is surprising, in impetuosity he does not lose sight of propriety. In his carriage his neck is curved as a bow, and this brings his chin to touch his breast."

Thus during the age in which Vegetius lived it seems that horses of various breeds existed on Roman territory, and were used for many useful purposes—for the chariot and for the saddle, for pleasure and for war,—but even at this period horses had not been yoked to the plough, the occupation of the farm-horse proper had not commenced; his spirited nature had hitherto exempted him from agricultural labour, which was performed by the mules and the oxen, and for this reason much attention was bestowed on these last-named animals. Indeed, a law was enacted to protect them, and so severe was it that death was the penalty for abusing them. The wearing down of the hoof-horn of unshod horses might have prevented their being used for the prolonged labour of the plough, or their light build might not have adapted them for drawing heavy burdens, which the lethargic dispositions of the ox and mule rendered them capable of performing with comparative ease: but for war and chase the horse remained an important factor, and whatever incapacitated him from these uses received the diligent attention of the Romans. The greatest evil they dreaded were injuries to his unshod feet. To prevent such accidents, sandals and other foot armatures were prescribed.

The Latin authors who wrote on this subject to a great extent copied the writings of Grecian authors, especially in the treatment of equine diseases and the means to be adopted in order to harden the hoofs of their unshod horses. For instance, Xenophon advises that the best way to harden horses' hoofs is to cause them constantly to be implanted on hard stones. Columella, with the same motive in view, suggests in the place of hard stones the use of oak boards for horses to stand on.

Not only did the Romans attempt to protect their horses' feet from injury, by applying sandals, &c., and by adopting measures calculated to harden them; they also laid down those mighty highways, the Roman roads, which were so constructed as to ensure smooth surfaces over which their horses might pass.

The existence of these roads enabled the Romans to extend their conquests, for they were thus brought in contact with nations who possessed horses which were better adapted for war than their own, and which, as before stated, although they were smaller than those of Italy, were more

agile, and consequently possessed the facility of rallying and retreating with greater rapidity than the somewhat bigger-framed Roman horse. This breed appears to have been obtained originally from Etruria, and it was upon horses of this kingdom that Romulus mounted his *equites* or cavalry. These were also the animals which supplied the circus with its first equine performers, and the battle-field with its charger; and there is little doubt but that the size of the Roman horse was derived from the Etruscan. Confirmation of this assertion is afforded by the discovery in an Etruscan graveyard of a wall-painting on which horses are depicted so large as to be quite out of proportion to the car to which they are attached. Whether the carriage is drawn too small, or the horses too large, cannot now be determined, but the picture, as it exists, suggests that the Etruscan horse at that date was a large animal. During the incursions made by the Romans into Germany and into Gaul large horses were found, and in Bavaria and the neighbourhood large horse-shoes have been exhumed from tumuli. The Germans are represented by Tacitus as a big race of men possessed of great bodily strength, who devoted their life almost exclusively to martial exercises and hunting, in the performance of which they required large horses to carry them. These facts to a certain degree show that an indigenous breed of large horses existed in mid-Europe, which by admixture assisted in developing the tournament horse, and ultimately in the production of the British wagoner. A large breed of horses also existed in Spain before it was conquered by the Moors, and these were probably the descendants of the horses on which the soldiers of Hannibal at the battle of Cannæ were mounted. In other parts of the world there is no evidence of the existence of large horses; in fact they seem generally to have been small, for the horse-shoes excavated from tumuli evidently have been worn by ponies not 14 hands high, and experience teaches us that the horse becomes small as he approaches the tropics and the Arctic regions, but that in a medium temperature, like that of mid-Europe, he gains size, and, if he is combined with Arab blood, he gains pluck and endurance also. In Asia, Africa, and North Europe the native breeds of horses remain small, as they were in the past; and Cæsar, when he invaded our country, found only an indigenous race of small ponies. England is now the possessor of the finest horses in the world, both large and small, but she obtained the materials from which they were bred from foreign countries—size from Flanders and Lombardy, and quality and elegance of form from Africa and Arabia.

THE HORSES OF ASIA AND AFRICA

THE ARAB AND THE BARB

Both Africa and Arabia claim to have been the birthplace of the great Eastern race of horses. Some say that Africa gave the horse to Arabia, and others that the Arabians migrated to Africa. Such migration, according to Eusebius, did occur. He informs us that some of the early descendants of Cush settled on lands on the eastern side of the Red Sea, and gradually moved to the south of Arabia, whence they crossed the sea and transplanted themselves into Ethiopia. The Ethiopians, we are told, agreed in many points with the Arabian Cushites, and were believed by most Asiatic nations in the time of Josephus to have originated from the same source. At the period when these Arabians passed over into Africa, namely, during the time the Israelites were in Egypt, other African natives besides the Egyptians possessed horses, and battles had been fought with chariots and horsemen before these Arabians arrived in Africa. Consequently horses must have been fairly well distributed on African soil before their introduction into Ethiopia by the Cushites. Of course the idea of migration has resulted from the belief that the equine species originated from a single pair. It may be thought that it matters little whence the horse originated, but in reality it is most important. For if the various animals emanated from single pairs, the horse from one stallion and one mare, then we have to account for the distribution of varieties, and how different equine types have been developed; whereas if we accept the theory of the evolution of several varieties in different regions of the globe, it will not be difficult to understand how, by intercourse between different types of the same species, distinct breeds have been brought into existence. That this mode of development has taken place during the historic period is evident; we know how the large horses of mid-Europe have been improved by commerce with those of the East, how the hobby, the race-horse of Queen Elizabeth's time, by intermingling with the Arab, has led to the ultimate production of the English thoroughbred, and how thousands of years before this period, this great Eastern breed was sought after by civilized and quasi-civilized nations—by Assyrians, by Babylonians, and by Egyptians—for his qualifications as a hunter and a chariot horse. The African horse was introduced into the hippodrome by the Greeks, and into the circus by the Romans, and at the present day the great performers in the hunting-field and on the turf are descendants of the Barb or the Arabian.

There is no doubt that horses of the highest qualifications have through all ages come from tropical, or at least warm regions, and the Arab horse is believed by many to have been the parent of the equine race, or at least to have been the first domesticated variety.

Although the Arabs claim their descent from Ishmael, it must be remembered that many provinces in this country had been inhabited before Hagar was banished to the desert by Abraham. Joktan ruled over Yemen, and his youngest son, Jorham, founded, it is said, the kingdom of Hejaz, while his posterity "kept the throne until the time of Ishmael". Consequently Ishmael, when he lived in the wilderness of Paran, was in contact with a settled and somewhat civilized population, who possessed horses, and who most likely had subjugated them; for we know that on the eastern side of Arabia the Babylonians and the Assyrians had employed horses in battle, and that the wild life the Arabs led, owing to the nature of the country, induced them in their earliest days to train horses for hunting and martial pursuits. The prediction that their hand should be against every man, and every man's hand against theirs, has been fulfilled. From the time of this utterance to the present day the Arabs have lived by attacking and plundering caravans which pass through the desert, and this they could not have accomplished so easily had they not possessed swift horses to overtake the travellers, or to escape by rapid flight from foes too strong for them to overcome. This desert life was, therefore, a great incentive to the production of the world-famed Arab, whose services from the most ancient times every civilized nation has acquired, either by purchase or by capture in war. Both Greece and Rome hired Arabian and African cavalry to assist them in their conquests, and on more than one occasion the onslaught of these splendid horses and horsemen converted a threatened defeat into victory. The auxiliaries also of other nations who assisted the Romans in the battle-field rode upon horses who owed their excellence to the result of a cross between their native breeds and the Arab.

The Persians, early in their history, obtained from the desert horses which, by intermingling with the indigenous stock of the country, produced a breed second only to their half-brothers the Arabians, whose descendants formed the magnificent Persian horse so celebrated in history for its brilliant exploits in time of war. The same story could be repeated of other nations whose cavalry was composed of horses in whose veins flowed the blood of the Arab. When the Saracens extended their dominion by conquest, the distribution of their horses in the various conquered countries still further assisted in the diffusion of Arab blood among the many native equine races. In fact, it was propagated in the East and in the West

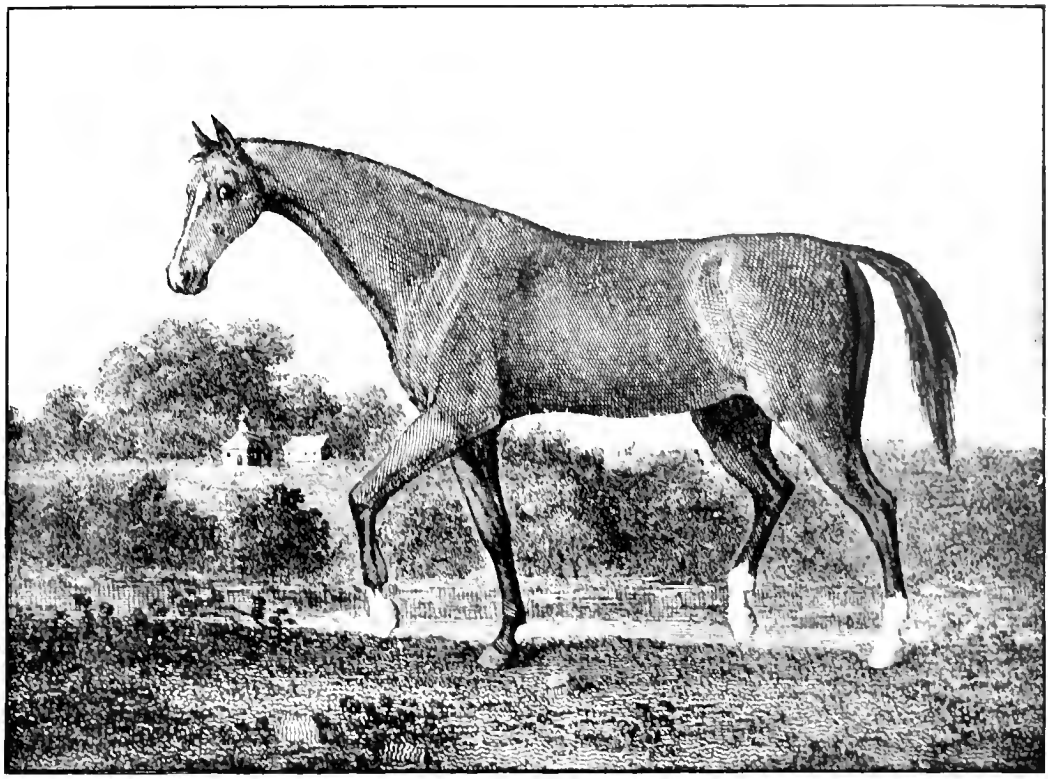
in the train of the Arabs who subsequently penetrated to the limits of the known world.

After the introduction of Islamism, new Mussulman invasions extended the fame of Arab horses to Italy, to Spain, and even to France, where, without doubt, they have left traces of their blood. But the event which more than any other filled Africa with Arab horses was the invasion of Sidi-Okba, and still later the successive invasions of the fifth and sixth centuries after the Hegira. It was not until the days of Mohammed that the important qualifications of the Arab were fully recognized. By the Arabs the horse is considered to be a divine gift, and his protection and kind usage to be a divine duty; blessings also are to attend those who keep horses. "Whosoever keeps and trains a horse for the cause of Allah is counted among those who give alms day and night: publicly or in secret he shall have his reward. All his sins shall be forgiven and never shall dishonour his heart."

The Mohammedan conquests extended from the centre of Asia to the western verge of Africa, and a great part of Spain was long held by the Moors or the Arabs. In all the territories they acquired by the sword, there the Arab horse always left his impression on native stock, or remained in such regions to perpetuate, unsullied by admixture, the purity of his race. In no country is this so observable as in Spain; for in this country, when European nations possessed only very indifferent equine stock, Spain was celebrated for her splendid breed of horses. No doubt these animals had been obtained from the Moors during their 800 years' possession of Andalusia, during which period the Arab horse had conveyed his good qualities to the mares of the surrounding country. The jennet, doubtless, is a descendant of these horses, but previously to the occupation of Andalusia by the Saracens, two breeds of horses existed in Spain: one, the ancient war-horse, which Gervase Markham and the Duke of Newcastle considered in their days the best charger and most accomplished menage horse, "an animal unrivalled in war and not to be excelled in equestrian exercises"; the other, the horse indigenous to the country, used in ancient times as a beast of burden, to carry packs like the mule, the descendants of this breed being still used in the same capacity as their ancestors. Both these breeds had been improved by intercourse with the Arab horse during the domination of the Moors. But previously to this date an improvement had been effected by the introduction of Eastern blood, and when the Duke of Newcastle eulogized the Spanish horse he praised not the native-bred horse, but a breed which derived much of its excellence from relationship with the Arab. Honian, a Nestorian physician at Bagdad, 850 A.D., brought out editions

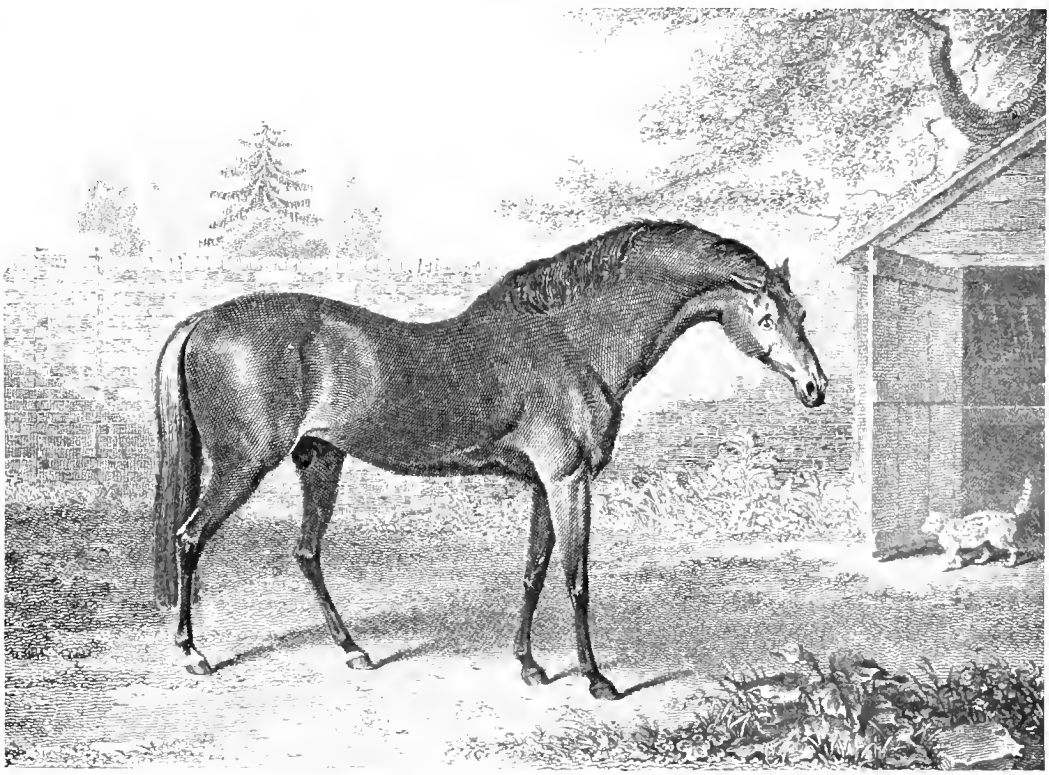
of Aristotle, Plato, Hippocrates, Galen, and others, and also biographies of celebrated horses in which the pedigrees of these animals are clearly traced back for thousands of years, their performances narrated, and their services rendered to their masters in battle and in the chase recorded, the highest praise always being bestowed upon the descendants of the mares ridden by the prophet in his flight from Mecca to Medina. It is not to be wondered at that Mohammed valued the horses of the desert so highly when we consider the services they rendered to their masters in war, and that, without their assistance, the vast Mohammedan conquests could not have been secured. The horse consequently became an object of the utmost respect, and means were resorted to in order to ensure that the Arab horse, in all his purity of descent, should be handed down to posterity. It is owing to his purity of blood that this animal, both in the past and in the present, has made such a useful stock-getter. No other horse in the world can be depended upon to stamp his likeness on his progeny as the Arab, and it is for this reason he has improved the various breeds of horses throughout the world. It is thought by many that the Barb is a better horse and a more celebrated sire than the Arab, and in this opinion Arabian authorities agree; but they do not consider that this animal forms a distinct breed, only that he has descended from Arabs which were imported into Africa, and in that country produced offspring superior to those grown in Arabia.

Accounts of the migration of the Arab horse into Africa, and thence into other parts of the world, tend to show that European horses have derived their best qualifications more from the Barb than the Arab, *i.e.* from the region of the Sahara; and it certainly is the breed that both in prose and verse is the most highly praised. But whether they are both of the same descent is not of much importance, since one fact is patent, namely, that from both breeds European horses have obtained those characteristics designated quality and high breed. There is little doubt that it was with Barbary horses the Moors invaded Spain, and that during the many years they remained there the blood of the Barb was communicated to her native breeds, from which crosses the jennet and the celebrated Spanish war-horse arose. The exploits of these improved breeds have been handed down to us both by Spanish and by Arabian authors. We are told of their feats of daring and their splendid performances, and to what a great extent the smiles of the fair sex and their commendation incited the equestrians to deeds of valour. These were the days of chivalry and of a civilization introduced into Andalusia by the Moors and the Jews. This great intellectual development was checked by the expulsion of the Moors and the Jews, who, nevertheless, left behind



THE DARLEY ARABIAN

From a contemporary engraving



THE GODOLPHIN ARABIAN

After a painting by G. Stubbs, R.A.

them libraries, and among other things interesting manuscripts on equitation and the treatment of horses, and these have been handed down to us either directly or through the medium of Spanish literature. On the departure of the Moors most of their property was confiscated. Their horses, from which neither love nor money would part them, were seized or sold for a tenth of their value. These remained in Spain, and from Spain many of their descendants were distributed over Europe, and soon after found their way into England.

THE HORSE IN BRITAIN

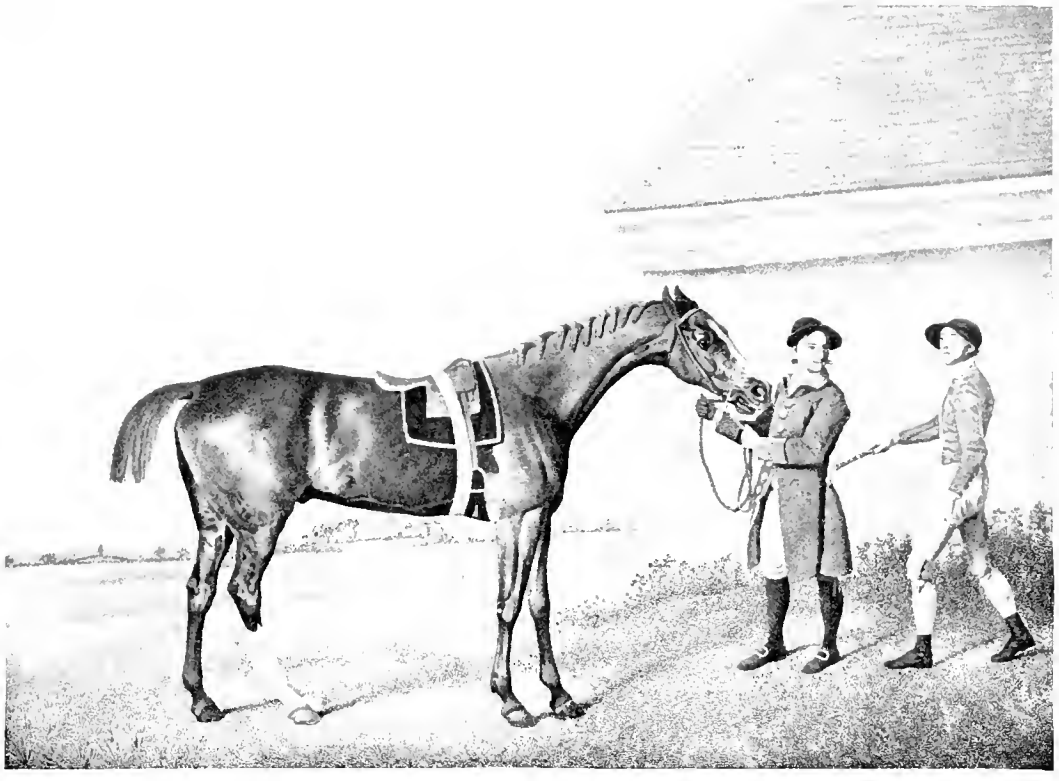
Before the commencement of the Christian era Rome, which had become "mistress of the world", extended her conquests in Asia and in Africa, and ultimately reached the shores of Great Britain. The landing of Cæsar was hotly opposed by the Britons with a strong force of cavalry, which they furiously drove between the ranks of the enemy, discharging their darts, as they rushed along, with such dexterity as to inflict considerable loss on the invaders. In his account of the invasion of Britain, Cæsar writes: "When they engaged the horse they left their chariots to fight on foot, their charioteers in the meantime retiring and placing themselves so that their masters, if overpowered by numbers, might readily find them and have an easy retreat. By this manner of fighting, they had both the speed of the horse and the steadiness of the foot, and they were by daily practice so expert that they could stop their horses on a steep descent, though in full career, turn them in a narrow compass, run along the pole, sit upon the yoke, and from thence, with incredible quickness, return to their chariots." This is the first historical account we have of the existence of horses in Britain. Whether these animals were indigenous to the soil, or whether they were descendants of horses imported by other nations, such as the Phœnicians who, it is said, traded with the Britons as early as the Trojan war, cannot be ascertained. Neither are we able to discover their exact type; we only know that they were small. As the horse-shoes found in Roman and in Saxon tumuli were only of a size sufficient to fit small hoofs, and as the size of the shoe indicates to a great extent the size of the animal whose foot during life it had protected, it is reasonable to assume that the original breeds of British horses were small. In all northern countries of Europe the indigenous equine races have always been represented by diminutive breeds of ponies. The domestication of the horse has led to his improvement, and the knowledge of man has assisted in securing his progressive development, especially

by judicious crossing and by the careful selection of parents. During the time the Romans were extending their conquests in Britain distinct evidence is afforded, not only of the vast number of horses that existed in the country, but also of the large importation of them by the Romans. When in 54 B.C. Cæsar landed a second time in England, he brought with him 20,000 foot and a very powerful body of cavalry, with which he defeated the petty prince Cadwallon in every action. So numerous were the horses of the Britons, however, that their leader was able to bring 4000 chariots to impede the Roman advance. The imported Roman horses no doubt were of a mixed breed, whose ancestral line of descent during centuries had been improved by careful supervision; consequently these animals, being much larger than the native ponies, would be capable by intercourse between them of producing "fresh crosses of good blood" in which both great quality and size might be anticipated. During the 400 years the Roman sway continued, horses from the Continent were constantly landed on our shores, and British ponies were also transported to Rome. Subsequent to the departure of the Romans from Britain the invasions of other nations led to the further introduction of foreign horses. Saxon and Danish horses found their way into this country, and thus laid the foundation for the production of improved breeds. Little specific mention is made of the British horse until 631, when Bede informs us that the prelates, who had previously performed their journeys on foot, at this date rode on horseback, and always used mares instead of horses as a mark of humility.

When Judith, the daughter of Charles the Bald, king of France, came to this country on her marriage with Ethelwolf, we learn she was attended by numerous horsemen who rode "magnificent Spanish horses"; but it is not until the reign of Alfred the Great, the fourth son of Ethelwolf, that we obtain any distinct information that horses received especial care, or that their propagation was intelligently supervised. This prince was well qualified to inaugurate this important business, as he had visited Rome, where he met many learned churchmen and others, from whom he received not only his early lessons in religion and in secular matters, but also in equestrian exercises, in which the patrician Roman youth took a great delight. This youthful visit to Rome placed him in a position to make constant observations, and particularly concerning the various breeds of horses, from among which those most conspicuous for their beauty and other qualifications could be selected. There is no doubt the pastimes indulged in by the Romans did not escape the notice of Alfred, and when he arrived at man's estate he was possessed of such knowledge as enabled him to inaugurate a system of horse-

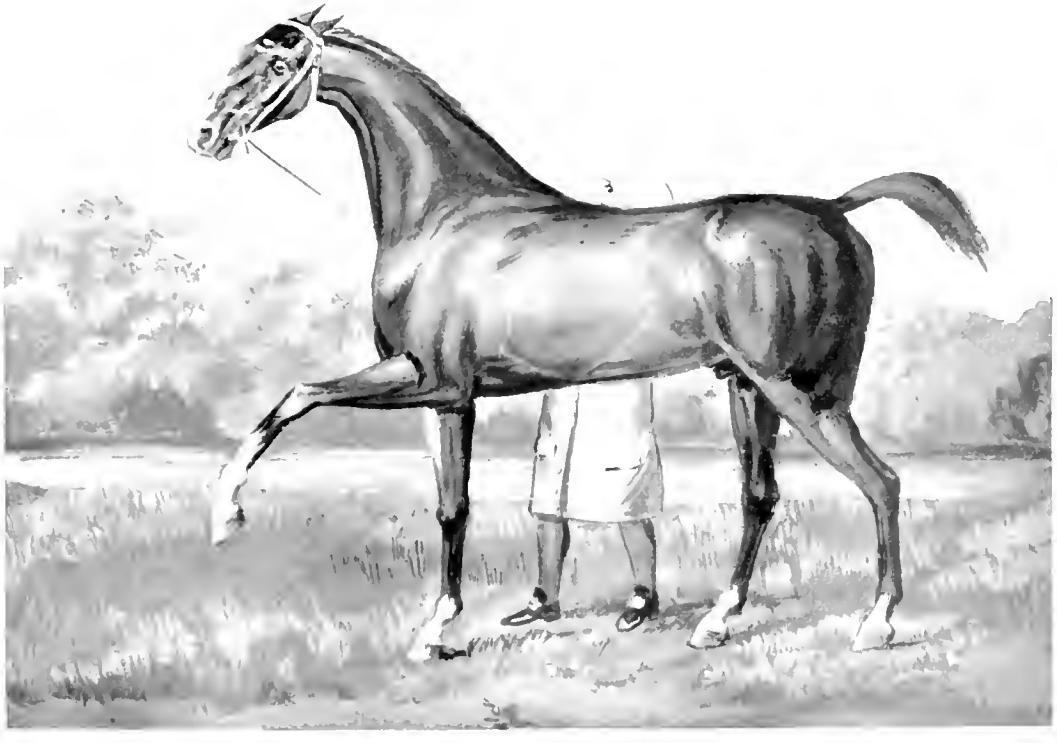
breeding, and assisted him in making selections from among those foreign horses which he had admired on the Continent, with a view to mate them with the indigenous breeds of Britain. Alfred was not only a large importer of horses, but also imposed laws calculated to operate in improving indigenous breeds; and in order to ensure that his mandates should be thoroughly carried into effect he appointed a stud-groom or master of the horse, who received the title of Horse Thane. The duty of this officer was to superintend the breeding, training, and management in health and in disease of the royal horses. During this reign horses both foreign and native were bought and sold, but it was not until Athelstane ascended the throne, 925 A.D., that horse-dealing became a vast commercial pursuit. Laws were enacted designed to regulate the price and otherwise to protect purchasers against fraud. If a horse were destroyed or lost through negligence, the owner was entitled to "thirty shillings compensation, for a mare or colt, twenty shillings, for an untrained mare, sixty pence, for a mule or an ass, twelve shillings". Athelstane was a large importer of foreign horses, but he would not allow English horses to leave the country, proving that at this early date the value of British breeds was recognized, and therefore their exportation was prohibited by law. The importation of Continental horses was encouraged, and nothing gave Athelstane so much pleasure as the receipt of presents in the shape of horses. We read: "Sundry princes sought his alliance and friendship, and sent him rich presents, the finest horses, with golden furniture," &c. These are said to have been "running horses", probably nags of moderate size, adapted for purposes of display, of hunting, and of chariot-racing, which sports represented the pastimes of this period. Athelstane evidently highly valued these presents, for in his will he enumerates and makes a disposition of them: "Those given me by Thurbrand, together with those given me by Liefbrand," &c. During this reign it is evident that numerous horses existed in Great Britain, and that intelligent measures had been adopted to cause their propagation and their improvement, and to prevent any decrease in their number: moreover, the law prohibiting their exportation was rigorously enforced. During the following reigns it was the function of the horse thane to superintend the cultivation and the propagation of horses. When William the Conqueror landed on British territory he brought with him from Normandy a large army, consisting of archers, light and heavy armed infantry and cavalry, and the superiority of the Norman horse no doubt largely contributed to William's victory at the battle of Hastings. The history of this memorable event shows us that the Norman horses landed on these shores remained permanently in this country, and contributed

to the increase of British stock and to the improvement of the native breeds. William, at the battle of Hastings, rode a Spanish charger, and the Bayeux tapestry depicts some of the equine types that were imported on this occasion; all the boats of the invading army are full of horses. "Every knight has a small pony, on which he rides without armour, whilst the great war-horse is led by a squire." Thus history records certain exact equine types that were landed on these shores by William. His charger, most likely, was a Spanish jennet, and the cavalry on both sides were small, even those that were yoked to the chariots; but the great horse upon which the knight entered the combat made his first appearance on the British coast at Hastings. From this importation the tournament horse arose, and, centuries after, the heavy cart-horse. The great horse was strictly a war-horse, and was used also for parade and for display, but light horses were employed in the chase. The Conqueror, who was devoted to this pastime, laid many villages waste in order to secure large open plains for his favourite pursuit of hunting, and no doubt the chase was the cradle in which the future racer was primarily nursed. At this period Roger de Belesme, Earl of Shrewsbury, in order to improve the existing type of horse then in the country, introduced Spanish stallions into his Welsh estate of Powisland. The excellent qualifications of these animals are recorded by Giraldus Cambrensis, and their praises are celebrated by the poet Drayton. The Norman nobles who settled in England distributed both large and small horses throughout their newly acquired possessions, and during the Plantagenet dynasty horses from the East and from Lombardy were landed on these shores. Béranger describes these horses as being adapted "for war purposes and exhibition of public assemblies, of which horses are always an essential and ornamental part". As yet horses had not been attached to the plough, oxen having been employed in the art of husbandry, and even up to a very recent period the horse had been exempted from this service. At the time of the Norman Conquest the horse had been employed in agricultural labour, however, as the Bayeux tapestry gives a picture of a man driving a horse drawing a harrow. In the reign of Henry I two horses of Barbary were imported into this country, one being presented to the king and the other to the church of St. Andrews, by Alexander the First of Scotland. This is the first notice we have of Oriental horses having been imported into Great Britain. Youatt says that some authors have asserted that from these two horses sprung the English thoroughbred a statement which he thinks "is devoid of foundation". This may or may not be the case, but if they were Barbs or Arabians they certainly were of the right breed from which race-horses could be produced,



ECLIPSE

From the painting by G. Stubbs, R.A.



FLYING CHILDERS

From the Painting by Sartorius after Seymour

since it is from such stock that Eclipse and Flying Childers descended. Fitz-Stephen, who lived during Henry II's reign, gives a description of the public exhibition of horses: how at Smithfield (*planus campus*) they were paraded for sale. "Every Friday, except some festival intervene, there is a fine sight of horses brought to be sold. Many of the city come to buy or look on, to wit, barons, knights, earls, and citizens. It is a pleasant thing to behold the horses there, all gay and sleek, moving up and down, some on the amble and some on the trot, which latter pace, although rougher to the rider, is better suited to men who bear arms. There are yet colts, ignorant of the bridle, which prance and bound and give early signs of spirit and courage; there are also managed war-horses, of elegant shape, full of fire, and giving every evidence of a generous and noble temper; horses also for the cart, dray, and plough are to be found here."

The tournament on the Continent had been for many years a pastime with warriors, but the love of hunting to which the English nobles were devoted delayed its becoming a British institution until the time of Henry II. At this time Fitz-Stephen tells us that on every Friday in Lent a tournament was held at Smithfield, where young Londoners armed and mounted on horses performed a variety of warlike evolutions, and from this age the tournament ruled supreme both in England and on the Continent until the reign of Queen Elizabeth, when the race-course gradually pushed out of existence this ancient pastime. The tournament was not established in England until sixty years after the Norman conquest, but from the account of Stephanides of Canterbury it is evident that during the reign of Henry II various equine breeds were common in England, the charger or tournament horse being spoken of as distinct from the cart-horse. These animals were the descendants of imported Norman horses, and were representatives of an improvement that had been impressed upon native stock by the judicious selection of parents under the supervision of their owners. During the Plantagenet dynasty the chase became the incentive which led to the propagation of swift horses, and in the same way the tournament operated in causing the production of the great horse; and consequently we find that during the reign of King John the development of the great horse was continued. We read that this monarch imported one hundred stallions from Flanders, and, as the tournament was at this period a great national institution, we may presume that these animals were destined for performance in the tilting yard and at the same time for purposes of the stud. The value set upon these horses during this reign is indicated by a fine that King John imposed upon a person named Till, who "possessed a noble breed of horses", but falling under the king's displeasure was condemned to pay

a fine of ten horses, each worth thirty marks, about £300 of our present currency. These were the days when large horses were in request, and when kings and nobles vied with each other in attempting to procure by importation and by breeding magnificent specimens of the "great" horse, and also lighter bred animals for the chase. Soon after Edward II ascended the throne we find a commission is given to one Bynde Bonaventure for twenty war-horses and twelve draught horses to be purchased in Lombardy. John de Trokelow, in 1307, bears testimony to the care this prince bestowed on horses and the zeal with which he attempted their improvement. Edward III was an ardent supporter of the tournament and the chase, and warmly encouraged the importance and breeding of light and heavy horses. It is recorded that this monarch purchased fifty Spanish stallions for 1000 marks, and imported from France four great horses, for which he paid Count Hainault 25,000 florins. This prince also introduced horse-racing, in which sport Spanish horses seem to have been engaged, and those animals which performed on the turf were named running-horses. During this reign the various breeds of horses were separated into classes, each breed being distinguished by a name indicating the use in which each respective class was employed. Laws also were enacted to prevent dishonest dealing and to control prices; and as the laws were principally directed against owners residing in Lincolnshire, Cambridgeshire and Yorkshire, we can perceive that even then these counties were considered favoured localities for breeding and rearing horses. The equine importations mentioned above consisted of large horses from Flanders and from Lombardy, and of light ones whose ancestors had been bred in Africa or in Arabia; and it is from these two breeds that our race-horses, hunters, and heavy wagoners have by gradual and progressive development derived their origin.

The Crusades offered an opportunity to the warriors who left this country for the Holy Land, to note the excellence of the horses ridden by the Saracens, and on their return to this country they brought with them many Asiatic horses, which became the progenitors of that stock whose descendants in the days of the first Stuart and later were conspicuous on the race-course. These horses most likely had descended from the stock with which Mohammed and his followers had waged war, and were represented by Barbs, by Arabs, by Persians, and by Turks. They were small, as they are to this day, *i.e.* not more than 14½ hands high, but from these animals the English pony gained size and the charger quality. For the tournament the light Arab-looking horses imported by the Crusaders would have been useless. For this pastime heavy horses were obtained, and it was from intermixture between these two types that quality was acquired and greater size

induced. Upon such steeds the warriors of old faced their enemies in the battle-field and on the tilting-ground, encased in armour so weighty that it sometimes demanded the assistance of two squires to mount them. Chargers of great size were imported by Anglo-Normans, by Plantagenets, and by Tudors from Flanders and from Lombardy, and Chaucer gives a distinct picture of this breed when he depicts its grand conformation in the following verse:—

> "For it so high was, so broad and long,
> So well proportioned for to be so strong,
> Right as it were a steed of Lombardy".

After the time of Richard the First there is little to record of importance relative to the breeding, rearing, and importation of horses, until the reign of Richard the Third, when we learn for the first time that during 1483 post-horses and stages were first introduced, and that horses were specially employed in this service. Soon after the first Tudor ascended the throne we are put in possession of interesting facts relative to the treatment and disposition of horses by Polydore Virgil, who tells us how cattle and horses browsed over English pastures and common lands, and that horses, both mares and entire horses, were mingled together, which caused so much confusion and disorder that Henry VII enacted that no entire horse should be pastured out on fields or common lands. This law caused such horses to be kept within bounds and tied in stalls, whence the name "stallion" or "stalled one" was applied to the entire horse. The inconvenience of this enactment in causing so many horses to be stabled led to their emasculation, which from this date became a common practice. The exportation of stallions and of mares of less value than six shillings and eightpence was prohibited, but the importation of foreign horses was warmly encouraged as previously. Henry VIII, like his father, paid particular attention to the raising and the improvement of horses, and it is evident from the laws that were passed during his reign that small horses were too numerous. In his endeavour to obtain a stronger and better type of animal a law was enacted that no stallion less than 15 hands high and no mare less than 13 hands should run wild in the country. A colt two years old and under 11½ hands high was not allowed to run on any moor, forest, or common where mares were pastured; and at Michaelmastide the neighbouring magistrates were ordered to drive all forests and commons, and not only to destroy such stallions, but also "all unlikely tits whether mares or foals".

Other enactments were passed during this reign with a view to obtain more powerful horses. It was enjoined that every bishop and duke was to keep seven entire horses, each above three years old and not less than

14 hands high; those failing to obey this law were subjected to heavy penalties. Every clergyman holding a benefice of £100 per annum, and all those whose wives wore French hoods or velvet bonnets, were liable to a fine of £20 unless they kept one stallion "and kept and rode upon stallions not less than 15 hands high". Edward VI passed a law prohibiting the importation of stallions less than 14 and mares less than 13 hands high, and horse-stealing was made a felony. It is certain, therefore, that in 1550 great attention was bestowed by Englishmen in attempting to secure a better type of horse than had previously existed in the country. Yet the progress to perfection was very gradual, since we learn from Blundeville, who lived in the days of Elizabeth, that two classes of horses existed, "very indifferent, strong, slow, heavy-draught horses, or light and weak". Moreover, it is a notorious fact that during this reign horses were scarce. Whether this was owing to the destruction of the "unlikely tits" or some other causes cannot be determined, but history informs us of the scanty and meagre display the British cavalry made at Tilbury Fort when assembled there to be inspected by Elizabeth; and Carew in his *History of Cornwall* suggests that it was to the wholesale slaughter-laws of Henry VIII that the almost total loss of small horses was attributable, "formerly so common in that part of England and Wales".

During the Plantagenet and the Tudor periods two classes of horses existed in England, "running horses" as they were called, and war or tournament chargers; but the great horse of the past was as inferior to the Shire horse of to-day as the Barbs and Arabians of the Stuart epoch would be to the thoroughbreds of this era. During the reign of the first Tudor the demand for great horses was on the wane; battles being fought with artillery rendered heavy armour defenceless, and led to the employment of armour of a lighter description. This, however, was only partially adopted, and then more for ornament than use. Ladies of high rank who had been accustomed to ride by the side of gentlemen on pillions soon discontinued this practice after the appearance of carriages, which were introduced by the Earl of Arundel in 1580. Heavy horses, no doubt, were primarily attached to these cumbrous vehicles. Their novelty attracted the attention of the rich, which ultimately led to better designs in the construction of coaches, and as they were made to decrease in weight the demand for lighter horses increased. During Elizabeth's reign the days of the tournament were drawing to a close, consequently one of the incentives to the propagation of heavy horses was vanishing away. Whether the discontinuance of this pastime or the introduction of carriages assisted in causing the decrease in the horse supply which was noticed in the scanty display of cavalry at Tilbury Fort, it is impossible to determine. We know that at

this time private race-meetings were instituted, to be followed later by public ones, and that "nags" were in demand, and although carriages had been introduced they were used only to a very limited extent. Ben Jonson tells us how the grandees rode on horseback to the theatres, and that when the great Shakespeare fled to London, from terror of a criminal prosecution, his first expedient was to wait at the doors of theatres and hold the horses of those who had no servants, in order that they might be in readiness for their owners after the performance. In this capacity he became so conspicuous for his careful attention that in a short time all who alighted called for William Shakespeare, and scarcely anyone was trusted with a horse if William's services could be obtained. Accordingly he hired boys to act under his orders, who were called Shakespeare's boys, and for years afterwards those who took charge of horses at the doors of theatres were known as Shakespeare's boys.

At this period a more active breed of horses began to be propagated as the effect of causes previously narrated, such as the disuse of heavy armour. This gave rise to the cultivation of light "nags", the existence of which, a year after the Spanish Armada, Sir John Smythe deplores. He writes: "Their horsemen, serving on horseback with lances or any other weapon, think themselves well armed with some kind of head-piece and a collar, on a deformed, high-bellied beast". As the occupation of the great tournament horse was "going", its propagation in great measure was discontinued; yet an incentive to the breeding of stout horses still existed, as such animals were required to draw the lumbering and heavy vehicles of this era across countries and plains, over bad roads or where none existed. During the Stuart dynasty consignments of large horses continued to be imported from Flanders and Northern Europe, together with Barbs, Turks, Persians, and Arabs, which by intermixture with our native breeds and between themselves succeeded in forming the ancestral stocks from which all British equine breeds have emanated.

The British cart-horse's descent can be traced from the great horse originally imported from Flanders and Lombardy, but much improved since those days by judicious crossing and careful selection of parents. The Stuarts first introduced quality, but size was wanting; for when William III ascended the throne, and sought to drain the Lincolnshire Fens, he found that the British cart-horse of this date was not strong enough for the tasks imposed upon him; consequently he imported large Dutch horses (the old Lincolnshire Blacks). The Dukes of Ancaster also brought over to this country similar breeds from Holland. This was the first step of any note which gave an impetus to the improvement of our coarser equine stock, and formed the main root from which our cart-horses have proceeded. Our

grandfathers have told us how their fathers expatiated on the merits of those horses, of their size and feats of strength, how the blacks with white legs and blazes were most esteemed. These animals or their descendants in time became located all over England, and thus a good cross of fresh blood found its way to the descendants of the old tournament horse, and procured that increase in size and strength for which our present breed of cart-horses are so celebrated.

During Elizabeth's reign horse-racing was in vogue, but it was only of a private nature. Matches against time and trials of speed between two horses represented the racing of this period. It was left for James I to introduce into England the sport he had previously established in Scotland. He inaugurated races at Gatterley, in Yorkshire; at Croydon, and at Theobalds at Enfield Chase. He encouraged every kind of horsemanship, the importation of foreign horses, especially of a racing type, and was the first to land upon our shores a pure-bred Arabian, which he bought of a merchant named Markham for £500. This animal turned out a failure, and well it might, if the description given of him by the Duke of Newcastle in his treatise on horsemanship was correct, "a little boney, bay horse of ordinary shape and almost worthless"; but James, nothing daunted, purchased of Pace, afterwards stud-master to Cromwell, a horse brought from the north coast of Africa, and known as the White Turk. The example set by James was followed by his friends. The first Duke of Buckingham imported the Helmsley Turk, and Lord Fairfax the Morocco Barb. From this date improvement in our breed of light horses commenced. But although Eastern horses were in demand to effect this object, their qualifications had only been partially recognized, for we find Gervase Markham stating "the true English-bred horse to be superior to those of any other country. I do daily find in my experience that the virtue, goodness, boldness, swiftness, and endurance of our true-bred English horses is equal to any race of horses whatsoever. For swiftness, what nation has brought forth the horse which has exceeded the English? When the best Barbaries that ever were were in their prime, I saw them overcome by a black hobby at Salisbury, and yet that black hobby was overcome by a horse called Valentine, which Valentine neither in hunting or running was ever equalled, yet was a plain-bred English horse both by dam and syre." From this quotation it can be seen that among native stock good specimens existed, upon which the imported Oriental blood was about to give its impression of further excellence. These were the days when the love of racing created the demand for swift horses, and the turf an incentive to their importation and propagation. At this epoch the most successful performers on the turf, both horses and mares, were distinguished from common stock by being classified

as professional race-horses, and public race-meetings were formally gazetted as at this day.

In the time of Charles I the importation and breeding of swift horses continued, for supplying both the turf and the hunting-field with good performers. The order of the day was for fast gallopers, who were rapidly supplanting the tournament horse, and to so great an extent as to have caused the presentation of a memorial to the king complaining of the great diminution of stout and powerful horses "fit for the defence of the country", and urging that measures should be adopted in order to encourage the propagation "of this useful and important type of horse". To promote the object sought, a law was enacted but never was put into execution, and consequently became a dead letter. It was impossible, therefore, to keep up a large supply, as the demand for this class of horse had considerably diminished. The turf had usurped the occupation of the tilting-yard, and the great horse had been supplanted by the racer. At the same time a necessity still remained for the production of weight-carriers to draw vehicles laden with heavy goods, and to carry men in armour—for even at this date armour formed no inconsiderable portion of the trooper's uniform,—and consequently a demand for "stout and powerful horses" still existed, but not to so great an extent as during the Tudor era. During the civil wars racing was neglected, but the importance of cavalry horses exercised a powerful influence in causing the production of horses possessing both strength and activity, and to the development of this type Cromwell gave his attention. He raised a cavalry regiment, the best in existence at that date, composed of powerful yeomen and stout horses. He on two occasions (February 24, 1654, and April 8, 1658) prohibited horse-racing, declaring all persons of what "estate, quality, or degree soever, who should appoint or assist at race-meetings, breakers of the public peace, and further requiring all civil and military authorities to seize all the race-horses and spectators"; but he generally encouraged the breeding of stout, active horses, with a view to procuring animals with speed and endurance, which he recognized were more useful on the march and on the battle-field than those chargers which possessed "mere bone and bulk". It can, therefore, be seen that during the Commonwealth the demand for cavalry horses was the incentive which led to the production of animals possessing bulk combined with activity, and this result was obtained from crosses between the weight-carrier and racer of this era. Thus a new type of horse was created, namely the active cavalry horse, whose descendants at a later date drew the heavy springless vehicles of our forefathers over rotten and almost impassable roads.

Although during the stormy days of civil war, horse-racing had been neglected, after the third Stuart was crowned king this sport became a

national institution. The Merry Monarch was the greatest supporter of the turf England has ever known. He not only encouraged and patronized the race-courses already in existence, but he also added to those established by his father at Hyde Park, Newmarket, and at other places, that at Datchet Mead, near Windsor, being the most celebrated. Newmarket became his favourite resort. There he built a palace and large stables, which he filled with Eastern horses obtained by his Master of the Horse for breeding purposes. These animals were Arabians and Barbs, both stallions and mares, which latter and also some of their produce were called royal mares. During this reign Oriental horses were numerously imported, and racing began to assume an improved character. Treatises on horses were issued from the press, and one on horsemanship, published by the Duke of Newcastle, gives descriptions of various foreign horses, and advice relative to breeding them for specific purposes—for war, the menage, and the turf,—and he selects the Barb as his ideal of what a horse should be. He writes: "The Barbary horses I freely confess are my favourites; I allow preference as to shape, strength, natural air, and docility. Mountain Barbs are horses of the best courage; many of them bear marks of wounds they have received from lions." The same author also suggests how an improvement can be effected upon native stock by careful selection of parents. "The best stallion is a well-chosen Barb or beautiful Spanish horse. Some people believe that a Barb or Jennet produces too small a breed. There is no fear of having a horse too small in England, since the moisture of the climate and fatness of the land rather produces horses too large. In choice of breeding mares I would advise you to take either a well-shaped Spanish or Neapolitan; when these are not easily obtained, then a beautiful English mare of good colour and well marked." Previously to this reign we may assume that winning mares and stallions were mated in order to secure and perpetuate a race of flyers; but when the imported Arabs and Barbs were discovered to be faster on the turf than the native stock, they were introduced to the harem with a view of procuring in the offspring that turn of speed which was common to the foreign horses. This combination resulted in success, which was primarily effected by such horses as Dodsworth Pace's White Turk, and numerous other Barbs and Arabians, whose stock in later reigns laid the foundation from which the superiority of the English horse arose. During the short reign of James II there is little about horses worth mentioning. Oriental horses were still imported. The Lister Turk was brought to England by the Duke of Berwick, being taken at the siege of Buda. This horse was the sire of many celebrated horses: Snake, Brisk, Conyskins, &c. The king was devoted to hunting, and kept a large stud of hunters. He is said to have been a fine horseman, and for this

reason the Irish gave him the name "Shamus-na-cappul" (James of the horses).

William III was an enthusiastic horseman and lover of the menage horse. He built a riding-school, in which it pleased him to be an inspector of equestrian exercises. He also was a great supporter of the turf, and kept a magnificent stud of Oriental horses, and thus assisted in the gradual improvement in the breeds of horses that had been commenced by James I. During this reign the Byerley Turk was brought to this country. This animal was Captain Byerley's charger during William's wars in Ireland, and was the sire of Sprite, Black Hearty, Grasshopper, &c. Queen Anne gave every encouragement to horse-racing. She kept race-horses, which were entered for prizes in her own name; she added also several plates in different parts of the kingdom. The importation of Oriental horses had now become quite a mercantile pursuit. Numerous Barbs, Turks, and Arabs were landed on our shores, but the most conspicuous of them was the Darley Arabian, which was brought to this country from Aleppo in 1715, the year after George I came to the throne. This animal was the sire of Flying Childers, the fastest horse over a long distance that ever ran; that is if his record be correct, which asserts that he ran over a course at Newmarket, a distance of 3 miles 6 furlongs and 93 yards, in 6 minutes and 40 seconds, the Beacon course of 4 miles 1 furlong and 138 yards in 7 minutes and 30 seconds, and also could run a mile in a little over one minute. This remarkable record of speed may be too good to be true, but whether exaggerated or not, it is certain that this animal was the fastest horse of his day, and that from him the thoroughbred has derived a large proportion of its present excellence.

In 1725 another celebrated horse, the Godolphin Arabian, arrived in this country, and from him have descended most of the notable horses now on the turf. In tracing the descent of thoroughbred horses it will be observed that they emanate from three distinct sources: "The Darley Arabian, 1720, from whom descended Childers, Squirt, Marske, Eclipse, King Fergus, Hambletonian; the Byerley Turk, 1689, whence came Jig, Partner, Tartar, Herod, Highflyer, Sir Peter, Woodpecker, Buzzard; and the Godolphin Arabian, 1725, whence came Cade, Matcham, Conductor, Trumpeter, Sorcerer, Dr. Syntax. From the first source our present stallions are Orlando, Wetherbit, Cossack, King Tom, Teddington, Touchstone, Stockwell, Voltigeur, and Rataplan. From the second, Sweetmeat, Alarm, Cowl, Flying Dutchman, Tadmor, Wild Dayrell; and from the Godolphin Arabian, Nutwith, West Australian, Sir Tatton Sykes, Tomboy, and Melborne. Wetherbit, Tomboy, and the Doctor are the eighth cross from the Arab; Bradsman, Touchstone, and Melborne the ninth; West Aus-

tralian, Surplice, Voltigeur, Kingston, Chanticleer, and Fisherman the tenth; Cossack, Ignoramus, Pelion, Tadmor, Ellington, Longbow, are the eleventh generation." Florizel II, Persimmon, and Diamond Jubilee, three brothers by St. Simon out of Perdita II, bred by His Majesty King Edward VII, are among the living representatives of these famous sires. On the female side the royal mares consisted chiefly of importations of Barbs from the north coast of Africa when Tangiers was under the British flag, but many of them were English bred, and were selected because they had been successful performers on the turf. The late Admiral Rous was of opinion that the English race-horse has descended from "pure-bred Arabs", untainted by English blood, and whose pedigree might be traced for two thousand years—the true offspring of Arabia Deserta,—and the greater size and height that the produce of these animals attained to he ascribed to the climatic influence of "these damp, foggy islands", assisted by judicious management and good "pasture". But does our knowledge of the past history of the horse warrant us in accepting this assertion as a fact? Do not the writings of the Duke of Newcastle advise crossing with a fine English "mare"; and do not other sentences show that intermingling with different breeds was resorted to by our forefathers as the best means by which to improve the then existing British race-horse? The admiral attributes the superiority that the race-horse of the Stuart era obtained to our "damp, foggy climate", combined with good pasture and judicious management; and although he speaks of the first cross as producing our primary first-class race-horse, in the next sentence he asserts that the Turks, Barbs, and royal mares were pure Arabians, "pure Eastern exotics, without a drop of English blood in their veins".

If climate and good pasture caused all the improvement which it is allowed did occur, how was it that previously to the days of the Stuarts the benefits derived from climatic influence had not been recognized by the Tudors? If environment alone was capable of producing greater size in our equine races, what need had Henry VIII to pass a law ordering the destruction of small horses and "all unlikely tits", when the same "fog and damp" was ready to promote the same increase of size which we are asked to believe was the sole cause of the change? Every physiologist knows the benefit that arises from a "good cross of fresh blood". Almost all the breeds of domestic animals have been brought to their present excellence, not by continuous breeding in a direct line in the same family, but by judicious out-crossing, and it was by the adoption of this system at the outset that the British thoroughbred has been produced.

In 1618 Michael Barrett had noticed the benefit that arose from cross-breeding. He writes: "Although the Spanish jennet, and Irish hobby and

the Arabian courser are held by Maister Blundeville and Maister Markham to be the chief for racing and neat action, there is the bastard stallion begotten by one of them on our English mares which doth exceed either of them in swiftness and toughness".

Of course it is impossible at this distance of time to trace distinctly the pedigree of the horses and mares imported during the Stuart epoch, although it is certain that to these importations the superiority in our breeds is attributable. Some of the royal mares were purchased in Hungary, but Admiral Rous thinks the majority came from Morocco, and that the Barbs were brought during the sixth century from Arabia, when the Saracens overran and conquered Northern Africa. That all these were highly bred and were of Eastern origin cannot be doubted, and their introduction into this country resulted in the improvement of native breeds and in developing the British thoroughbred.

Writers in the past bear testimony to this fact, and cite instances and describe the processes that have been adopted in their attempts to improve present or establish new breeds. Clive, "On the good effects of crossing", writes: "We are told that the great improvement in the breed of horses in England arose from the crossing with those diminutive stallions, Barbs and Arabians, and the introduction of mares from Flanders into this country was the source of improvement in the breed of cart-horses.

"When the Asiatic horses were mated with native-bred English mares, there was size on one side and superior quality on the other, the mare exhibiting size and greater development of bone and muscle, but lacking that 'density of fibre' and vital energy which was possessed by the Barb in an eminent degree. From such combination it might be anticipated that the offspring would grow to greater size than the sire, and would show as it arrived at maturity a good proportion of the Eastern horse's quality. And this is exactly what did take place. Animals of size and quality were obtained from the first crosses, and from the Stuart epoch to the present day our race-horses have, decade by decade, increased in height. In 1730 the Oriental horse was denounced, and it was the opinion of sportsmen at this date that the immediate *uncrossed* descendants of Eastern horses had of late years, almost without exception, proved so deficient that breeders would no more have recourse to them than the farmer would to the natural oat, which is little better than a weed, to produce a sample that should rival that of his neighbours in the market. Were the finest Eastern horse that could be procured brought to the starting-post at Newmarket, with the advantage of English training to boot, he would have no chance at any weight or for any distance with even a second-rate English race-horse." From this quotation we learn that the cross-bred English racer was a gustier racer on

the turf than the pure-bred Barb or Arabian, proving how great had been the influence of the incorporation of the old English blood with that of the Eastern horse. The celebrated horses, the Darley and Godolphin Arabians, impressed upon the British racing stock a vigour, a power, and a physical development which has been handed down through succeeding generations "from sire to son". The great Eastern horse, to which we owe so much, has preserved through thousands of years a distinct line of descent from the days when Ninus, King of Assyria (2227 B.C.), marshalled his chariots and horses in battle and Pharaoh pursued the Israelites to the Red Sea (1401 B.C.). This breed of horses, whose existence at the above dates is recorded, were the primogenitors of the Barb and Arabian, who have through countless ages improved the various indigenous species of the world; and at the present day the quality, whenever noticed in foreign horses, has always been obtained directly from the Arab or indirectly from the British thorough-bred, which has impressed his likeness on all our existing breeds from the cob to the cart-horse, to which the American trotter is indebted for much of his excellence, and which, into whatever country he enters, is acknowledged to be king of the equine race.

GLOSSARY

A

Abrus (Gr. *abros*, pretty), Indian liquorice, the seeds of *Abrus precatorius* or wild liquorice.

Abscess (Lat. *abscessus*, a separation of matter), a collection of pus in some of the organs or parts of the body, the result of local inflammation.

Absorbent (Lat. *absorbere*, to suck in), a drug or medicine that produces absorption of diseased tissue.

Acetabulum (Lat., a small cup), the cavity into which the head of the femur or thigh-bone fits and in which it moves.

Actinomyces (Gr. *aktis*, a ray, and *mykēs*, mushroom), a rayed fungus.

Acute (Lat. *acutus*, sharp), pertaining to disease having a rapid and severe onset, progress, and termination.

Adenoid (Gr. *adēn*, gland, and *eidos*, appearance), resembling a gland.

Æstrum (Gr. *oistros*, gadfly), the heat or rut of animals; the sensation occurring at the time of coition.

Afferent (Lat. *afferens*, carrying to), carrying something to a centre; hence, applied to those nerves which conduct influences to the central nervous system.

Ala (Lat., a wing), a name of various wing-shaped parts.

Alveolus (Lat.), the bony socket of a tooth.

Amaurosis (Gr. *amauros*, dark), partial or total loss of vision.

Amide (*amaonia*), a white crystalline solid often capable of combining with both acids and bases.

Amphiarthrosis (Gr. *amphi*, around, and *arthroa*, a joint), a joint in which there is a disc of fibro-cartilage between the ends of the bones; it enjoys a limited movement.

Amylolytic (Gr. *amylon*, starch, and *lusis*, solution), effecting the digestion of starch.

Amylopsin (Gr. *amylon*, starch, and *opsis*, appearance), a ferment said to exist in pancreatin.

Anæmia (Gr. *an*, priv., and *haima*, blood), deficiency or thinness of blood.

Anæsthesia (Gr. *anaisthēsia*), want of feeling, a nervous disease.

Anæsthetic (Gr. *an*, priv., and *aisthēsis*, feeling), a substance that produces insensibility to feeling or acute pain.

Anchylosis, Ankylosis (Gr. *ankylos*, a stiff joint), union of the bones forming a joint, resulting in a stiff joint.

Aneurism (Gr. *aneurysma*, widening), a dilatation or widening in the course of an artery.

Animalcule (Lat. *animaleulum*, a minute animal), a microscopic animal.

Anodyne (Gr. *an*, priv., and *odynē*, pain), a medicine that relieves pain.

Anthrax (Gr. *anthrax*, a coal, or carbuncle), a fatal disease due to the bacillus of anthrax.

Antidote (Gr. *anti*, against, and *didōmi*, to give), a drug that prevents or counteracts the action of poisons.

Antipyretic (Gr. *anti*, against, and *pyretos*, fever), an agent which reduces the temperature in fever.

Antiseptic (Gr. *anti*, against, and *sēptos*, putrid), an agent which prevents putrefaction.

Antispasmodic (Gr. *anti*, against, and *spasmos*, a spasm), an agent that relieves spasm.

Anus (Lat.), the fundament, the posterior opening of the large bowel.

Aorta (Gr. *aortē*), the largest artery of the body. It arises from the heart, and divides into the anterior and posterior aorta.

Aphthæ (Gr. *aphthai*, an eruption), small white spots or vesicles occurring in the mouth, more especially seen in young animals.

Aponeurotic (Gr. *apo*, from, *neuron*, tendon), pertaining to a broad fibrous membrane or tendon proceeding from a muscle, or used to bind down tendons.

Apophysis (Gr. *apo*, from, and *physis*, growth), a process of bone produced from a separate centre of growth.

Apoplexy (Gr. *apoplēxia*, a striking down), loss of consciousness from breakage of vessels in the brain.

Aqueduct (Lat. *aqua*, water; *ductus*, a leading), applied to ducts and canals in various parts of the body.

Arthrodia (Gr. *arthrōdia*, a kind of joint), a joint permitting a gliding movement.

Ascites (Gr. *askitēs*, a kind of dropsy; *askos*, a bag), an abnormal accumulation of serous fluid in the cavity of the belly; dropsy of the belly.

Ascococcus (Gr. *askos*, a leather bag; *kokkos*, a kernel), micro-organisms made up of round colonies surrounded by tough, thick, gelatinous envelopes.

Aseptic (Gr. *a*, priv., and *sēptos*, putrid), free from pathogenic bacteria or septic matter.

Aspergillus (Lat. *aspergere*, to scatter), a genus of fungi.

Asphyxia (Gr. *a*, priv., and *sphyxis*, the pulse), suffocation, the effect produced by depriving the lungs of air.

Assimilation (Lat. *assimilare*, to make like), the transformation of food into a condition in which it may be used up in the nutrition of the body.

Astragalus (Gr. *astragalos*, a die), the bone upon which the tibia rests.

Astringent (Lat. *ad*, to; *stringere*, to bind), an agent which, by contracting organic tissue, arrests hæmorrhage or diarrhœa.

Atavism (Lat. *atavus*, a forefather), the reappearance of an anomaly in an individual whose more or less remote progenitors were similarly affected, but in whose immediate ancestors it had not been shown.

Atlas (from the fabulous Atlas that supported the earth), the first bone of the cervical or neck vertebræ, supporting the head.

Atrophy (Gr. *atrophia*, want of nourishment), loss of weight, size, and function of an organ.

Auricle (Lat. *auricula*, the outer ear), the name for the two superior cavities of the heart.

B

Bacillus (Lat. *bacillum*, a small rod), a name for various microscopic organisms or microbes of a rod-like form, some of them associated with certain diseases.

Bacterium (Gr. *baktērion*, a little stick), a genus of short cylindrical fission fungi; a bacillus. See above.

Basilar (Gr. *basis*, base), pertaining to the base, usually of the skull.

Biceps (Lat. *bis*, twice; *caput*, the head), a term applied to several two-headed muscles.

Bicipital (Lat. *bi*, two; *caput*, the head), pertaining to the biceps muscle.

Biologist (Gr. *bios*, life, and *logos*, discourse), one who is a student of life forms.

Bishoping, the act of carving a cavity in the crown of a tooth and making it black by heat, for the purpose of making an old horse appear young.

Blepharitis (Gr. *blepharon*, the eyelid, and *itis*, inflammation), inflammation of the eyelid.

Blepharophimosis (Gr. *blepharon*, the eyelid, and *phimōsis*, a shutting up), constriction or narrowing of the opening of the eyelids.

Brachial (Lat. *brachium*, the arm), pertaining to the upper arm.

Bruit (Fr., a noise or report), a term used to designate the specific sounds of auscultation.

Buhonocele (Gr. *boubōn*, the groin, and *kēlē*, tumour), inguinal hernia, or hernia in the groin.

Buccal (Lat. *bucca*, the cheek), pertaining to the cheek.

Bulla (Lat. *bulla*, a bubble), a bleb or blister.

C

Calcaneus (Lat., the heel), the heel-bone; in veterinary anatomy, the bone which forms the point of the hock.

Calculus (Lat. dim. of *calx*, a small stone), a stone-like concretion found in the bladder and some other organs.

Callosity (Lat. *callus*, hard skin), a hard, thickened patch on the skin produced by excessive accumulation of the horny layer.

Capillary (Lat. *capillus*, a hair), a minute blood-vessel connecting arteries with veins.

Carbohydrate (Lat. *carbo*, coal; Gr. *hudor*, water), a substance containing carbon with hydrogen and oxygen in the proportion to form water.

Carboluria (*carbolic*, and Gr. *ouron*, urine), the presence of carbolic acid in the urine.

Cardiac (Gr. *kardia*, the heart), pertaining to the heart.

Caries (Lat. *caries*, rottenness), chronic inflammation of bone, followed by pus formation and death of the part.

Cariniform (Lat. *carina*, keel; *forma*, shape), applied to the keel-like cartilage in front of the breast-bone.

Carotids (Gr. *karōtides*), the principal right and left arteries of the neck.

Carpus (Gr. *karpos*, wrist), the eight bones collectively forming the wrist; the knee of the horse.

Carunculæ myrtiformes (Lat. *caruncula*, a caruncle; *myrtus*, a myrtle berry), projecting membranes near the orifice of the vagina—the remains of the hymen.

Casein (Lat. *caseum*, cheese), the substance precipitated from milk on the application of an acid or rennet.

Cataplasm (Gr. *kataplasma*, a poultice), a poultice.

Cavernous (Lat. *caverna*, a cave), having hollow spaces.

Cellulitis (Lat. *cellula*, a small cell; *itis*, inflammation), a diffuse inflammation of cellular tissue.

Cellulose (Lat. *cellula*, a little cell), wood fibre, the principal ingredient of the cell membrane of all plants.

Cement, Cementum (Lat. *cementum*, a rough stone), the crusta petrosa or outer crust of the teeth next the root.

Centimeter (Lat. *centum*, a hundred), a hundredth part of a meter, or about two-fifths of an English inch.

Cerebritis (Lat. *cerebrum*, the brain; Gr. *itis*, inflammation), inflammation of the brain.

Chestnuts, the oval-shaped horny masses situated on the inner side of the legs of horses, below the hocks and above the knees.

Cholesterin (Gr. *cholē*, bile, and *stereos*, solid), a glistening white substance found in bile and nervous tissue.

Chorea (Gr. *choreia*, dancing), a nervous disorder, characterized by convulsive twitching of muscles, especially of the limbs.

Choroid (Gr. *chorion*, a membrane), the second outer or vascular coat of the eye.

Chronic (Gr. *chronos*, time), long continued, slow of progress.

Chyle (Gr. *chylos*, juice), the milk-white fluid absorbed by the lacteals during digestion.

Chyme (Gr. *chymos*, juice), food as it leaves the stomach after it has undergone digestion.

Cilia (Lat. *cilium*, the eyelid or eyelash), the eyelashes; the minute hair-like processes on certain cells.

Circumvallate (Lat. *circumvallare*, to surround with a wall), surrounded with a wall or prominence.

Clitoris (Gr. *kleitoris*, clitoris), the homologue of the penis in the male, a small body situated at the entrance to the vagina.

Coccidia (Gr. *kokkos*, a berry), minute oval structures with a thick capsule and coarse granular contents, frequently found in the liver of the rabbit.

Coccus (Gr. *kokkos*, a berry), a spherical bacterium, a micrococcus.

Coccyx (Gr. *kokkyx*), a series of bones forming the terminal portion of the spinal column.

Cochlea (Lat. *cochlea*, a snail-shell), a cavity of the internal ear resembling a small shell.

Coition (Lat. *coire*, to come together), the act of sexual connection.

Collapse (Lat. *collabi*, to fall together), extreme depression and prostration from failure of nervous force, as in shock, hæmorrhage, &c.

Comminution (Lat. *comminuere*, to break to pieces), the breakage of a bone into several fragments.

Commissure (Lat. *committere*, to unite), a joining or uniting together; the line of junction of two parts.

Complemental (Lat. *complementum*, that which completes or fills up), the air that can still be inhaled after ordinary inspiration.

Congenital (Lat. *con*, together; *genitus*, born), existing at birth.

Contagion (Lat. *contagio*, *contingere*, to touch), the process by which a specific disease is communicated between animals, either by direct contact or by means of an intermediate agent.

Convulsion (Lat. *convulsio*, from *convellere*, to convulse), a general paroxysm of involuntary muscular contraction.

Co-ordination (Lat. *con*, together: *ordinare*, to regulate), the harmonious activity and proper sequence of operations of the various organs of the body.

Copulation (Lat. *copulare*, to couple), the act of sexual intercourse.

Coracoid (Gr. *korax*, a crow, and *eidos*, likeness), a beak-shaped process of the scapula.

Cornea (Lat. *corneus*, horny), the transparent anterior portion of the eyeball.

Cornu (Lat. *cornu*, a horn, pl. *cornua*), a name applied to any excrescence resembling a horn.

Coronet (Fr. *coronette*, dim. of *corone*, a crown), the second phalanx, or coronet bone.

Corpora lutea (Lat. pl. of *corpus*, a body; *luteus*, yellow), the yellow spots seen in the ovary, due to change in the blood clots of the Graafian follicle.

Corpora nigra (Lat. pl. of *corpus*, a body; *niger*, black), the masses of black pigment attached to the inner border of the iris.

Corpuscle (Lat. *corpusculum*, dim. of *corpus*, a body), any small round or oval body, as the minute corpuscles of the blood.

Cortical (Lat. *cortex*, bark), pertaining to the outer or surface part of an organ.

Cranium (Gr. *kranion*, the skull), the cavity that contains the brain.

Creatin (Gr. *kreas*, flesh), a neutral organic substance that occurs in the animal organism especially in the juice of muscles.

Crusta (Lat., a crust), a thin layer of bone covering the fang of a tooth.

Cryptorchid (Gr. *kryptos*, hidden, and *orchis*, testicle), a horse with one or both testicles which have not descended.

Cuboid (Gr. *kybos*, a cube, and *eidos*, resemblance), a bone of the hock joint.

Cul-de-sac (Fr. *cul*, the bottom; *de*, of; *sac*, bag), a passage closed at one end; a closed bag or sac.

Cuneiform (Lat. *cuneus*, a wedge), having the form of a wedge, said of a bone entering into the formation of the knee joint.

Cyst (Gr. *kystis*, a pouch), a cavity containing fluid surrounded by a capsule.

D

Dartos (Gr. *dartos*, flayed), a contractile fibrous layer beneath the skin of the scrotum.

Defecation (Lat. *defecare*—*de*, from, *fex*, dregs), the separation of dregs or lees; the discharge of faeces.

Deglutition (Lat. *deglutitio*, a swallowing), the act of swallowing.

Delirium (Lat. *delirium*, madness), impaired action of the brain, characterized by mental disorder, a staggering gait, &c.

Deltoid (Lat. *delta*, the Greek letter Δ, and *eidos*, likeness), having the shape of a delta or a triangular form.

Dentine (Lat. *dens*, a tooth), the bony structure of the tooth, lying under the enamel of the crown, and the cementum of the root.

Deodorizer (Lat. *de*, priv.; *odor*, a smell), a substance that destroys offensive odours.

Dermatology (Gr. *derma*, skin: *logos*, discourse), the science of the skin in health and disease.

Desquamation (Lat. *desquamare*—*de*, from, *squama*, a scale), the exfoliation or falling off of cuticle in scales.

Dextrin (Lat. *dexter*, right), the soluble matter into which starch is converted by diastase or by certain acids.

Diagnosis (Gr. *dia*, through, and *gnōsis*, knowledge), the interpretation of a disease from its symptoms.

Diagnostician, one skilled in making diagnoses.

Diapedesis (Gr. *diapēdēsis*, a jumping through), the passage of the cells of the blood, especially the white ones, through the walls of the vessels.

Diaphragm (Gr. *diaphragma*, a partition wall), the midriff, that is, the musculo-membranous partition that separates the chest from the abdomen.

Diaphysis (Gr. *dia*, between: *physis*, growth), the middle part or shaft of a long bone.

Diarthrodia, Diarthrosis (Gr. *dia*, throughout, and *arthrōsis*, articulation), a form of articulation or joint allowing extensive movement.

Diastema (Gr. *diastēma*, a distance), a space or cleft; an interval between different kinds of teeth.

Diathesis (Gr. *diathesis*—*dia*, through, and *tithenai*, to arrange), a condition of the body in which it is liable to certain disease.

Dicrotic (Gr. *dikrotos*, double beating), having a double beat of the heart.

Diphtheritic, relating to diphtheria.

Diplococci (Gr. *diploos*, double, and *kokkos*, berry), a micrococcus whose rounded bodies are found two and two.

Dipterous (Gr. *dis*, two, and *pteron*, a wing), two-winged, as a fly or a seed.

Discus proligerus (Gr. *diskos*, a disc; Lat. *proles*, offspring; *gerere*, to bear), the elevated cells of the membrana granulosa of the ovum.

Disinfectant (Lat. *dis*, neg.; *inficere*, to infect), an agent that destroys disease germs, and arrests fermentation and putrefaction.

Distoma (Gr. *dis*, double, and *stoma*, a mouth), a genus of trematode parasitic worms; one of them, the liver-fluke, is common in sheep.

Diverticulum (Lat. *divertere*, to turn aside), a small blind pouch or cul-de-sac, branching from some organ.

Dyscrasia (Gr. *dys*, bad, and *krasis*, combination), an abnormal state of the blood due to general disease.

Dyspnœa (Gr. *dys*, ill, and *pneō*, to breathe), difficult or laboured breathing arising from various causes.

E

Echinococcus (Gr. *echinos*, a sea urchin, and *kokkos*, a berry), same as *Echinococcus veterinorum*, a parasite of the tape-worm kind affecting domestic animals.

Écraseur (Fr.), an instrument used in the amputation of parts.

Ectoparasite (Gr. *ektos*, outside, and *parasitos*, a parasite), a parasite that lives on the exterior of its host.

Ectropium (Gr. *ek*, out, and *trepein*, to turn), an eversion or turning out of the eyelid.

Efferent (Lat. *efferens*, carrying from), applied to those nerves which conduct impulses from the central nervous system to some tissue; applied to vessels carrying fluid from some centre.

Electuary (Lat. *electuarium*, an electuary), a soft or pasty confection containing some drug.

Embolism (Gr. *embolos*, an embolus), obstruction of an artery from a blood clot or embolus.

Embryo (Gr. *embryon*), the fertilized germ of an animal.

Emollient (Lat. *emollire*, to soften), a substance used to soften the skin, or to soothe an irritated internal surface.

Emphysema (Gr. *emphysaein*, to inflate), an abnormal collection of air in the connective tissue of a part.

Emulsion (Lat. *emulgeo*, *emulsum*, to milk out), water or other liquid in which oil in minute subdivision of its particles is suspended.

Emunctory (Lat. *emungere*, to blow the nose, to wipe out), any organ that aids in carrying off waste matters from the body.

Enamel, the vitreous or glassy substance of the crown of the teeth.

Endarteritis (Gr. *endon*, within, and *arteria*, artery; *itis*, inflammation), inflammation of the innermost coat of an artery.

Endermic (Gr. *en*, in, and *derma*, the skin), relating to the administration of medicines by rubbing through the skin.

Endocarditis (Gr. *endon*, within, *kardia*, the heart, and *itis*, inflammation), inflammation of the lining membrane of the heart.

Endometritis (Gr. *endon*, within, *mētra*, the womb, and *itis*, inflammation), inflammation of the internal layers of the uterus.

Endoparasite (Gr. *endon*, within, and *parasitos*, a parasite), a parasite living within the body of its host.

Endosteum (Gr. *endon*, within, and *osteon*, bone), the vascular membrane lining the interior of a bone that contains marrow.

Ensiform (Lat. *ensis*, a sword; *forma*, form), shaped like a sword.

Entropium (Gr. *en*, in, and *trepein*, to turn), inversion or doubling in of the eyelid.

Environment (Fr. *environner*, to surround), the general conditions by which animals happen to be surrounded.

Enzootic (Gr. *en*, in, and *zōon*, animal), a disease to which beasts are liable in a certain district.

Enzyme (Gr. *en*, in, and *zymē*, leaven), any ferment found within the living organism.

Epididymis (Gr. *epi*, upon, and *didymos*, testicle), the small body lying above the testis.

Epileptic (Gr. *epilēptikos*, *epilēpsis*, a laying hold of), pertaining to or of the nature of epilepsy, or a sudden attack of unconsciousness.

Epiphysis (*epi*, upon, and *phyein*, to grow), a process of bone attached to a bone for a time by cartilage, but soon becoming ossified.

Epistaxis (Gr. *epistaxein*, to distil), hæmorrhage or bleeding from the nose.

Epithelium (Gr. *epi*, upon, and *thēlē*, nipple), the outer cellular covering of the skin and mucous membranes that line the cavities and canals of the animal body.

Epizootic (Gr. *epi*, upon; *zōon*, animal), a contagious or generally prevalent disease that may at times affect animals.

Equilibrium (Lat. *æquus*, equal; *libra*, balance), an even balance of a body.

Equinia (Lat. *equus*, a horse), glanders, farcy, a contagious disease affecting the horse and ass and communicable to man.

Ergot (Fr. *ergot*, spur), the horny projections situated behind the fetlocks of the horse.

Erythema (*erythēma*, a blush), redness of the skin that is removed by pressure.

Esophagus (Gr. *oisophagos*—*oisein*, to carry, and *phagein*, to eat), the tube extending from the mouth to the stomach; the gullet.

Ethmoid (Gr. *ēthmos*, a sieve, and *eidos*, likeness), the bone separating the nasal cavities from the cranium.

Etiology (Gr. *aitia*, a cause, and *logos*, discourse), doctrine or theory as to the cause of a disease.

Eucalyptus (Gr. *eu*, well; *kalyptein*, to cover), a name of various Australian trees, especially the blue gum-tree, that by distillation yields a camphor which is highly antiseptic.

Exanthema (Gr. *exanthēma*, eruption), an eruption upon the skin.

Excito-motor, pertaining to nerves that excite motion, apart from the action of the will.

Excrementitious (Lat. *excernere*, *excretum*, to separate), pertaining to fæces or excrement.

Exomphalus (Gr. *ex*, out, and *omphalos*, navel), umbilical hernia, undue prominence of the navel.

Expectant (Lat. *expectare*, to look out for), applied to a plan of treatment which awaits the development of symptoms that would justify interference.

Extensor (Lat.), a muscle for extending or stretching out.

Extrinsic (Lat. *extrinsecus*, from without), external, outward.

F

Farcy-bud, a nodular swelling breaking out into an ulcer in glanders or farcy.

Ferment (Lat. *fermentum*, yeast), any micro-organism or other substance capable of producing the decomposition of large quantities of certain other substances by a process of *fermentation*.

Fibril (dim. of Lat. *fibra*, a fibre), a small fibre; commonly applied to minute nerve and muscular filaments.

Fibrin (Lat. *fibra*, a fibre), a substance common in animal bodies, and readily obtained from coagulated blood in a stringy form.

Fibrinogen (Lat. *fibra*, a fibre, and Gr. *gennaa*, to produce), one of the principal elements in the formation of fibrin.

Fistula (Lat., a pipe), an abnormal tube-like passage in the body.

Foramen (Lat. *forare*, to pierce), a passage or opening, especially such as exist in bones. **Foramen lacerum basis cranii**, a large opening at the base of the skull, between the basilar process of the occiput and the temporal bones.

Formic acid (Lat. *formica*, an ant), an acid obtained from ants, nettles, the shoots of the pine, and various animal secretions.

Frenum (Lat., a curb), a ligament formed of various tissues that checks the movement of an organ.

Frenzy (Gr. *phrenes*, the mind), extreme and violent mania.

Frontal (Lat. *frontalis*, of the forehead), applied to the superior bone of the face.

Fungus (Lat. *fungus*, a toadstool), a plant of the class Fungi, which are parasitic plants without stems, leaves, or roots, made up of cells without chlorophyll or green colouring matter.

Funicular (Lat. *funis*, a cord), having a cord-like structure or shape.

G

Ganglion (Gr. *ganglion*, a knot), a small nervous centre or knot in which nerves meet, connected with other centres.

Gastrocnemius (Gr. *gastēr*, stomach, and *knēmē*, leg), a muscle of the leg having two heads, and forming part of the calf in man.

Germ (Lat. *germen*, sprig, offshoot, embryo), (*a*) a portion of matter having a tendency to assume a living form, an embryo; (*b*) a microbe or bacterium.

Glanders, a contagious disease more especially affecting horses, but sometimes communicated to man and some felines. Also called *Equinia*.

Glaucoma (Gr. *glaukos*, sea-green), a disease of the eye, giving rise to a bulging or hardening of the eyeball.

Glomerulus (Lat. dim. of *glomus*, a ball), a coil of arterial blood-vessels projecting into the widened end of each uriniferous tubule.

Glycogen (Gr. *glykys*, sweet, and *gennan*, to produce), a white amorphous powder occurring in the blood and the hair of animals.

Graafian follicle (*Graaf*, a Dutch anatomist; Lat. *folliculus*, a little sac), a name given to little sacs in which ova mature in the ovary of mammals; an ovisac.

Gracilis (Lat., slender), a muscle placed superficially on the inner part of the thigh.

Granulation (Lat. *granulum*, dim. of *granum*, a grain), fleshy outgrowths by which wounds are repaired.

Gregarina (Lat. *grex*, a herd), a genus of parasitic protozoa of very simple nature.

Gubernaculum testis (Lat.), the cord attached above the lower end of the epididymis to direct the descent of the testicle in fœtal life.

Guttural (Lat. *gutturalis*, from *guttur*, the throat), pertaining to the throat: in the horse, the large air-sacs lying behind the pharynx are termed the guttural pouches.

H

Habitat (Lat. *habitare*, to dwell), the natural locality and geographical range of an animal or plant.

Hæmoglobin (Gr. *haima*, blood; Lat. *globus*, a round body), a colloid or crystalline substance existing in the corpuscles of the blood, to which their red colour is due.

Hæmoglobinuria (from *hæmoglobin*, and Gr. *ouron*, urine), the presence of the red colouring matter of the blood in the urine. See above entry.

Hæmoptysis (Gr. *haima*, blood, and *ptyein*, to spit), discharge of blood from the stomach.

Helminth (Gr. *helmins*, worm), an intestinal worm.

Hemiplegia (Gr. *hēmi*, half, and *plēgē*, stroke), paralysis of one side of the body.

Hepatic (Gr. *hēpatikos*, *hēpar*, liver), pertaining to the liver.

Heredity (Lat. *hereditas*, from *heres*, an heir), the transmission of qualities or conditions possessed by the parent to the offspring.

Herniotome (Lat. *hernia*, hernia; Gr. *tomos*, cutting), a hernia knife.

Herniotomy (Lat. *hernia*, hernia; *tomein*, to cut), an operation for the relief of hernia by section of the constriction.

Herpes (Gr. *herpēs*, *herpein*, to creep), an acute disease of the skin in which groups of vesicles appear on a patch of inflammation.

Hiatus (Lat. *hiare*, to gape), a blank space or opening, as the hiatus aorticus.

Humerus (Lat.), the bone of the upper arm; in the horse, the bone between the knee and shoulder.

Hyaloid (Gr. *hyalos*, glass, and *eidos*, likeness), transparent like glass.

Hydatid (Gr. *hydatis*), a sort of bag or sac containing fluid, being the form which a tape-worm may assume within an animal body; an echinococcus.

Hydrogen (Gr. *hydōr*, water, and *gennan*, to produce), a gas occurring in nature chiefly in water, which consists of hydrogen and oxygen.

Hydrophobia (Gr. *hydōr*, water, and *phobos*, dread), a symptom of rabies consisting of an inability to swallow water.

Hygiene (Gr. *hygieinos*, good for health), the science of the laws of health.

Hymen (Gr. *hymēn*, membrane), a fold of mucous membrane at the entrance to the vagina.

Hyoid (Gr. *hyoeides*, similar to the Greek letter Upsilon or our letter Y), a term applied to various parts in anatomy, from their peculiar shape.

Hyperæmia (Gr. *hyper*, over, and *haima*, blood), a condition of congestion or excess of blood.

Hyperæsthesia (Gr. *hyper*, over, and *aisthēsis*, sensation), exalted sensibility of the skin.

Hypertrophy (Gr. *hyper*, over, and *trophē*, nourishment), excessive growth in the size of an organ.

Hypnotic (Gr. *hypnos*, sleep), pertaining to sleep; a remedy that causes sleep.

Hypodermic (Gr. *hypo*, under, and *derma*, the skin), pertaining to the introduction of medicines beneath the skin.

I

Icterus (Gr. *ikteros*, jaundice), jaundice.

Idiopathic (Gr. *idios*, own, and *pathos*, disease), not consequent on or dependent upon another disease, but having a known or recognized cause of its own.

Idiosyncrasy (Gr. *idios*, own, *syn*, together, *krasis*, a mixing), the special temperament pertaining to a person or an animal.

Ilium (Lat.), the haunch bone, or part of the innominate bone next the backbone.

Incisors (Lat. *incidere*, to cut), the cutting teeth, the six most anterior teeth in each jaw.

Incubation (Lat. *incubare*, to sit on eggs), the period which elapses between the implanting of the contagion and the development of a disease.

Indigenous (Lat. *indu*, in; *gignere*, to beget), native, not exotic.

Indolent (Lat. *in*, not; *dolere*, to feel pain), painless or sluggish, applied to ulcers, tumours, &c.

In extremis (Lat. *in*, in; *extremus*, last), a term implying extreme danger, or at the point of death.

Inflammation (Lat. *inflammatio*, a burning), a condition in which there is an abnormal accumulation of blood, with multiplication of the cells of the tissue or organ, attended with heat, pain, and swelling of the part.

Infundibulum (Lat. *infundere*, to pour into), the funnel-like depression on the crown of a tooth.

Infusoria (Lat. *infusum*, an infusion), a class of microscopic ciliated protozoa, being minute organisms found in fluids.

Inguinal (Lat. *inguen*, the groin), pertaining to the groin; *inguinal canal*, the canal which contains the spermatic cord in the male, and the round ligament in the female.

Innominate (Lat. *in*, without; *nomen*, a name), the term given to an irregular-shaped bone, the *os innominatum*, forming the sides and floor of the pelvis.

Insemination (Lat. *inseminare*, to plant seed), the introduction of the semen of the male into the uterus of the female.

Insufflation (Lat. *in*, in; *sufflare*, to puff), blowing any powder upon a surface or into a cavity.

Integument (Lat. *integumentum*—*in*, upon, *tegere*, to cover), an outer layer or covering, especially the skin.

Intercostal (Lat. *inter*, between; *costa*, a rib), applied to the space between the ribs.

Intercurrent (Lat. *inter*, between; *currere*, to run), applied to a disease arising during the existence of another disease in the same animal.

Intermaxillary (Lat. *inter*, between; *maxilla*, jaw-bone), between the maxillary or upper jaw-bones.

Intertrigo (Lat. *inter*, between; *terere*, to rub), an eruption or soreness of the skin produced by friction.

Intervertebral (Lat. *inter*, between; *vertebra*, a bone of the spine), between the vertebræ.

Intralobular (Lat. *intra*, within; *lobulus*, a lobule), applied to vessels passing into the lobules of the liver.

Intrinsic (Lat. *intrinsecus*, on the inside), inherent, inward.

Intussusception (Lat. *intus*, within; *suscipere*, to receive), invagination or doubling inward of one part of the intestine within another part.

Iris (Gr. *iris*, a coloured halo or circle), the anterior portion of the vascular tissue of the eye, surrounding the pupil.

Ischium (Gr. *ischion*, hip), the bone forming the posterior part of the os innominatum.

Isthmus (Gr. *isthmos*, isthmus), the neck or constricted part of an organ.

J

Jugular (Lat. *jugulum*, throat), pertaining to the throat, especially to two large veins of the throat.

K

Keratoma (Gr. *keras*, horn), a horn tumour; applied more especially to a growth from the hoof of the horse.

Kilogram (Fr. *kilogramme*, Gr. *chilioi*, one thousand, and *gramma*, a grain), a French standard weight, one thousand grams or 2·2 pounds avoirdupois.

L

Labial (Lat. *labium*, a lip), pertaining to the lips.

Lachrymal (Lat. *lacryma*, a tear), having reference to the organs secreting tears.

Lacteals (Lat. *lac*, milk), the lymphatics or vessels of the small intestine that take up the chyle.

Lamella (Lat. dim. of *lamina*, a plate), a term applied to a thin scale or plate of tissue, as the lamella of the foot of the horse.

Laminitis (Gr. *lamina*, plate: *itis*, inflammation), inflammation of the laminæ of the horse's foot.

Lampas (Fr. *lampas*, lampas), a fleshy swelling behind the upper incisor teeth in the horse.

Larval (Lat. *larva*, a ghost), pertaining to the condition of a larva, the larva being the early form of an animal quite different from the full-grown form.

Lecithin (Gr. *lekithos*, yolk of egg), a nitrogenous substance occurring widely throughout the body.

Leguminous (Lat. *legumen*, pulse), pertaining to the Leguminosæ or pea-flowered family of plants.

Leptothrix (Gr. *leptos*, thin, and *thrix*, hair), a genus of bacteria whose elements form straight filaments often of great length.

Leucin (Gr. *leukos*, white), a crystalline substance occurring in the pancreas, spleen, thymus gland, and other parts of the body.

Lichen (Gr. *leichēn*, a lichen), a skin disease in which there is an eruption of solid papules.

Lingual (Lat. *lingua*, tongue), pertaining to or shaped like the tongue.

Lithontriptic (Gr. *lithos*, stone, *thryptein*, to crush), applied to an instrument for crushing stone in the bladder.

Lithotomy (Gr. *lithos*, stone, *temnein*, to cut), cutting into the neck of the bladder to remove a calculus or stone.

Lithotrity (Gr. *lithos*, stone; Lat. *terere*, to rub), the operation of crushing a stone in the bladder by means of a lithotrite or crushing instrument, and removing it piecemeal.

Lobule (Lat. *lobulus*, a lobe), a small lobe or division of an organ.

Lumbricalis (Lat. *lumbricus*, a worm), a name of certain small muscles in the hands and feet.

Lunare (Lat. *luna*, moon), a bone of the carpus.

Lupus (Lat., a wolf), a chronic disease of the skin characterized by the development of nodules of granulation tissue.

Lymph (Lat. *lympha*, clear water), a colourless fluid allied to blood, and contained in vessels called *lymphatics*.

Lymphangitis (Lat. *lympha*, lymph; Gr. *angeion*, vessel, *itis*, inflammation), inflammation of a lymphatic vessel.

Lymphatic temperament, a condition of system characterized by flabby muscles, sluggish character, and a predisposition to diseases of a low type.

M

Macule (Lat. *macula*, a spot), discoloration of the skin due to hyperæmia or extravasation of blood, or to pigmentation of the skin.

Malar (Lat. *mala*, cheek), pertaining to the cheek or cheek-bone.

Malarial (It. *mala aria*, bad air), pertaining to malaria, a feverish disease common in many marshy districts.

Malic acid (Lat. *malum*, an apple), an acid formed in many plants and their fruit—apples, grapes, &c.

Mallein (Lat. *malleus*, farcy), a fluid obtained from the bacillus mallei—the micro-organism of glanders.

Malleolus (Lat. dim. of *malleus*, hammer), a process of bone having a hammer-like shape.

Marasmus (Gr. *marasmos*, *marainein*, to grow lean), a gradual, general deterioration in strength, with marked emaciation.

Massage (Fr., from Gr. *massein*, to knead), rubbing, kneading, and other manipulations of the superficial parts of the body.

Mastoid (Gr. *mastos*, breast: *eidos*, shape), having the shape of the breast or of a nipple, applied to a part of the temporal bone.

Meatus (Lat. *mare*, to flow or pass), a passage, duct, or canal.

Meconium (Gr. *mēkōnion*, lit. poppy juice), the first fæcal discharges of the new born.

Mediastinum (Lat. *medio stare*, to stand in the middle), a middle portion or septum separating adjacent parts.

Medulla (Lat. *medulla*, marrow), a structure enclosed in another structure, like the marrow of bone.

Medullated (Lat. *medulla*, marrow), forming a medulla, as nerve fibres enclosed in a medullary sheath.

Megacoccus (Gr. *megas*, large, and *kokkos*, a berry), a large-sized rounded bacterium or coccus: opposed to a micrococcus.

Megastoma (Gr. *megas*, large; *stoma*, a mouth), a genus of infusorians.

Megrims (Fr. *migraine*; Lat. *hemicrania*), neuralgia of one half of the head.

Melanosis (Gr. *melas*, *melan*, black), a general tendency to the deposit of black pigment in various parts of the body, mostly seen in grey horses.

Membrana nictitans. See *Nictitating membrane*.

Meningitis (Gr. *mēninx*, membrane, and *itis*, inflammation), inflammation of the membranes of the brain or spinal cord.

Merismopedia (Gr. *merismos*, division: *pais*, child), a bacterium multiplying by rectangular division, thus forming a group of four cells in one plane.

Mesentery (Gr. *mesos*, middle, and *enteron*, bowel), a fold of peritoneum connecting the small intestine to the spine and keeping it in place.

Mesorchium (Gr. *mesos*, middle; *orchis*, testicle), a fold of peritoneum containing the fœtal testicle before its descent.

Metacarpal (Gr. *metakarpion*, wrist), pertaining to the two bones between the knee and the fetlock joint of the horse.

Metro-peritonitis (Gr. *mētra*, womb), peritonitis secondary to inflammation of the womb.

Miasma (Gr. *miainein*, to pollute), a term having reference to germs generated in marshy districts.

Microbe (Gr. *mikros*, and *bios*, life), a vegetable or other micro-organism, often a disease germ.

Micrococcus (Gr. *mikros*, small, and *kokkos*, berry), a micro-organism having minute rounded elements, isolated, united in twos or in large numbers, or disposed in chaplets.

Microstoma (Gr. *mikros*, small, and *stoma*, mouth), abnormal smallness of the mouth.

Micturition (Lat. *micturitio*, *micturire*, to pass water), the act of passing water.

Mitral (Lat. *mitra*, mitre), resembling a mitre, said of a valve in the heart having two flaps.

Modus operandi (Lat.), the manner of operating or proceeding.

Molar (Lat. *mola*, a millstone), grinding or chewing; in the horse, relating to the twenty-four large teeth.

Monorchid (Gr. *monos*, single, and *orchis*, testicle), an animal in whom only one testicle has descended into the scrotum.

Morphology (Gr. *morphē*, form, and *logos*, discourse), the branch of science pertaining to form and structure.

Motor (Lat. *movere*, to move), a term applied to a class of nerves which transmit the power of motion to certain muscles.

Mucus (Lat.), a sort of slimy or viscid fluid secreted by membranes that line the mouth, intestines, &c.—hence called *mucous membranes*—and serving as a lubricant.

Mutualism (Lat. *mutuus*, reciprocal), the living together of organisms for mutual advantage; symbiosis.

Myelitis (Gr. *myelos*, marrow, and *itis*, inflammation), inflammation of the spinal cord.

Myocarditis (Gr. *mys*, muscle, and *kardia*, heart; *itis*, inflammation), inflammation of the muscular tissue of the heart.

Myopic (Gr. *myein*, to close, and *ōps*, eye), near-sighted.

N

Nausea (Lat. *nausea*; Gr. *nausia*, sea-sickness), sickness of the stomach, with inclination to vomit.

Navicular (Lat. *navicula*, a little ship), relating to the *navicular bone*, a bone in the foot of the horse, and to the synovial membrane of the *navicular joint*.

Necrosis (Gr. *nekrōsis*, from *nekros*, dead), death of a large portion of any tissue.

Nematode (Gr. *nēmatōdēs*, thread-like), resembling a thread; applied to certain parasitic worms.

Neoplasm (Gr. *neos*, new; *plasma*, form), a new growth or tumour.

Neurectomy (Gr. *neuron*, nerve, *ek*, out, *tomē*, a cutting), the operation of excising or cutting out part of a nerve.

Neurilemma (Gr. *neuron*, nerve, and *lemma*, husk), the outer sheath of a nerve.

Neuro-keratine (Gr. *neuron*, nerve, and *keras*, horn), a substance found in connection with some nerves.

Neurosis (Gr. *neuron*, nerve), a nervous disease, as epilepsy; a functional disease of the nerves or nerve centres.

Neurotomy (Gr. *neuron*, nerve, and *tomē*, a cutting), division of a nerve.

Nictitating membrane, a piece of cartilage in the inner canthus or angle of the eye, used to displace foreign matter from the surface of the cornea.

Nosology (Gr. *nosos*, disease; *logos*, discourse), scientific classification of disease.

Nucleus (Lat. *nucleus*, from *nux*, nut), a small body situated in the middle of a cell.

O

Obturator (Lat. *obturare*, to stop up), a part that stops up an opening: applied to the *obturator foramen* on the floor of the pelvis.

Occipital (Lat. *occipitalis*, occipital), pertaining to the occiput.

Occiput (Lat. *ob*, against; *caput*, the head), the back or hinder part of the head in man, and the corresponding part in animals.

Œdema (Gr. *oidēma*, *oidein*, to swell), a swelling due to the effusion of serous fluid into areolar tissue.

Oidium (Gr. dim. of *ōon*, an egg), a genus of parasitic fungi forming white disease of the vine; *Oidium albicans*, found in thrush on the tongue.

Olecranon (Gr. *ōlekranon*—*ōlenē*, elbow, and *kranion*, head), the large process at the head of the ulna.

Olein (Lat. *oleum*, oil), a constituent of fat composed of oleic acid and glycerine.

Omentum (Lat.), a fold of the peritoneum connecting the abdominal viscera.

Ophthalmia (Gr. *ophthalmos*, eye), inflammation of the eye.

Ophthalmic (Gr. *ophthalmos*, eye), pertaining to the eye.

Orchitis (Gr. *orchis*, testis, and *itis*, inflammation), inflammation of the testicle.

Osteo-porosis (Gr. *osteon*, bone, and *poros*, a pore), a disease of the bone which causes it to expand and to swell.

Ostitis (Gr. *osteon*, bone; *itis*, inflammation), inflammation of bone.

Ovariotomy (Lat. *ovarium*, ovary; Gr. *tomē*, a cutting), the surgical removal of an ovary.

Ovisac (Lat. *ovum*, egg, *saccus*, sack), the sac of an individual ovum; a Graafian follicle.

Oxalis (Gr. *oxalis*, sorrel), a genus of plants, the wood-sorrel, containing *oxalic acid*.

Oxyuris (Gr. *oxys*, sharp; *oura*, tail), a genus of nematode parasitic worms found in the intestines.

Ozone (Gr. *ozein*, to smell), an active oxidizing agent possessing antiseptic properties.

P

Palatine (Lat. *palatum*, palate), belonging to the palate, as the palatine bone.

Palmitin (Lat. *palma*, palm-tree), a constituent of animal and vegetable fats.

Palpation (Lat. *palpare*, to feel), the manipulation of a part with the hand or fingers.

Papilla (Lat., a nipple), any soft conical eminence, such as the nipple.

Papule (Lat. *papula*, a pimple), a pimple or small circumscribed elevation of the skin.

Paracentesis (Gr. *para*, beside, and *kentēsis*, puncture), tapping a cavity of the body, as in the case of dropsy.

Paralysis (Gr. *para*, beside; *lysis*, a loosing), loss of faculty in nerves, with consequent loss of action in muscles.

Paraplegia (Gr. *para*, beside, and *plēgē*, stroke), paralysis of the posterior half of the body.

Parasitism (Gr. *para*, beside, and *sitos*, food), mode of life of a parasite; infestation by parasites.

Paresis (Gr. *para*, from, and *hiemai*, to let go), slight paralysis.

Parietal (Lat. *parietalis*, *paries*, a wall), pertaining to the walls of a body cavity.

Pari passu (Lat.), side by side, with equal progress.

Parotid (Gr. *para*, near, and *ous*, *ōtos*, the ear), near the ear; as the *parotid gland* (which secretes saliva), *parotid arteries*, &c.

Parotitis (Gr. *para*, beside, *ous*, ear, and *itis*, inflammation), inflammation of the parotid gland.

Paroxysm (Gr. *para*, beside, and *oxys*, sharp), a fit or sudden attack of pain or convulsion.

Parturition (Lat. *parturitio*, *parturire*, to bring forth), the act of giving birth to young.

Patella (Lat., dim. of *patina*, dish), the knee-cap or small sesamoid bone in front of the stifle (where the thigh and leg bones articulate).

Pathogenic (Gr. *pathos*, disease, and *gennaō*, to beget), producing disease.

Pathognomy (Gr. *pathos*, disease, and *gnōmē*, a sign), the science of the signs by which disease is recognized.

Pathology (Gr. *pathos*, disease, and *logos*, discourse), that branch of medical science which treats of the modification of function and change of structure caused by disease.

Pectin (Gr. *pēktikos*, curdling), a vegetable body found in all plants.

Pectineus (Lat. *pecten*, a comb), a muscle deeply placed in the inner part of the thigh.

Pelvis (Lat. *pelvis*, a basin), the bony cavity of the posterior part of the trunk, in which are contained the rectum, bladder, and genital organs.

Pentadactylous (Gr. *pente*, five, and *daktylos*, finger), having five fingers.

Pentastoma (Gr. *pente*, five, and *stoma*, mouth), a genus of worm-like parasites.

Pepsin (Gr. *pepsis*, digestion), the chief digestive principle of the gastric juice.

Peptone (Gr. *peptein*, to digest), a product of the action of the gastric juice on albuminous substances, by which they are rendered soluble and capable of being absorbed.

Perforans (Lat. *per*, through; *forare*, to bore), applied to muscles whose tendon passes between the tendon of other muscles.

Perforatus (L. *per*, through; *forare*, to bore), applied to muscles whose tendon is divided in order to allow another tendon or structure to pass through.

Pericardium (Gr. *peri*, around, and *kardia*, the heart), the membranous sac enclosing the heart.

Perineum (Gr. *perinaion*), that portion of the body between the anus and the scrotum in the male, and the anus and vagina in the female.

Periosteotomy (Gr. *peri*, around, *osteon*, bone, and *tomē*, cutting), incision into the periosteum.

Periosteum (Gr. *peri*, around, and *osteon*, bone), a fibrous membrane covering bones.

Peristalsis (Gr. *peri*, around, and *stalsis*, constriction), the peculiar vermicular movement of the intestines and other tubular organs carrying onwards their contents.

Peroneus (Gr. *peronē*, the tongue of a buckle), a muscle situated on the outer side of the tibia or leg bone.

Pes anserinus (Lat. *pes*, a foot; *anser*, a goose), a plexus of nerves situated on the outer side of the face and resembling a goose's foot.

Pessary (Gr. *pessos*, a pessary), an instrument placed in the vagina to hold the uterus in position.

Petechiæ (It. *petecchie*), a name for small round blood-spots of a purple colour on the skin.

Petrous (Gr. *petra*, a rock), stony, like a rock.

Phagocytes (Gr. *phagein*, to eat, and *kytos*, cell), cells which take up and digest the soluble parts of various other cells, organisms, and excretion products; white blood-corpuscles.

Phalangeal, pertaining to the phalanges.

Phalanx, pl. **Phalanges** (Gr. *phalanx*, one of the bones of the fingers or toes), in the horse, applied to the large or small pastern, and the foot bone.

Pharyngitis (Gr. *pharynx*, pharynx, and *itis*, inflammation), inflammation of the pharynx.

Phimosis (Gr. *phimoun*, to constrict), enclosure of the penis within the prepuce so that the glans penis cannot be exposed.

Phlebitis (Gr. *phleps*, vein; *itis*, inflammation), inflammation of a vein.

Phlegmatic (Gr. *phlegmatikos*, like phlegm), the same as lymphatic, in the sense of sluggish or dull.

Phrenic (Gr. *phrēn*, diaphragm), pertaining to the diaphragm.

Phthiriasis (Gr. *phtheir*, a louse), lousiness, the lousy disease.

Pisiform (Lat. *pisum*, a pea; *forma*, form), resembling a pea in shape, applied to a small round bone of the knee.

Pityriasis (Gr. *pityron*, bran), a disease of the skin characterized by the exfoliation of bran-like scales.

Plantar (Lat. *plantaris*, *planta*, sole of the foot), pertaining to the sole of the foot.

Plasma (Gr. *plasma*, a thing formed or moulded), the fluid part of the blood and lymph.

Pneumogastric (Gr. *pneumōn*, lung, and *gastēr*, stomach), relating to the lungs and stomach.

Polypus (Gr. *polys*, many, and *pous*, foot), a tumour found chiefly on mucous membranes, as the nose, uterus, bladder, &c.

Popliteus (Lat. *poples*, ham), the ham or hinder part of the knee joint.

Portal (Lat. *porta*, gate), relating to that part of an organ through which the blood-vessels enter.

Post partum (Lat. *post*, after; *partus*, birth), following parturition.

Potential (Lat. *potens*, able), possible but not actual; possessing powers not yet manifested in action or effect.

Predisposing (Lat. *prae*, before; *disponere*, to dispose), applied to that condition of the body which renders an animal especially liable to contract disease.

Prehension (Lat. *prehendere*, to seize), the act of taking hold of or seizing.

Premolar (Lat. *prae*, before; *mola*, millstone), situated in front of the molar teeth.

Prognosis (Gr. *pro*, before, and *gnōsis*, knowledge), an opinion of the course and termination of a disease based upon a consideration of its symptoms.

Prophylaxis (Gr. *prophylassein*, to keep guard before), prevention or warding off of disease.

Prostate (Gr. *prostatēs*, prostate), the name of a gland situated in front of the mouth of the bladder.

Protagon (Gr. *prōtos*, first, and *agein*, to lead), a crystalline substance discovered in nervous tissue.

Proteid (Gr. *prōtos*, first), a general term for the albuminous and albuminoid constituents of the organism.

Protoplasm (Gr. *prōtos*, first; *plasma*, anything formed or moulded), the slimy albuminoid material resembling white of egg, constituting the basis of living plant or animal cells; living matter in its simplest form.

Protozoa (Gr. *prōtos*, first; *zōon*, animal), the lowest class of the animal kingdom, which consist of simple cells or colonies of cells.

Prurigo (Lat. *prurire*, to itch), a chronic papular inflammation of the skin attended with severe itching.

Pseudoplasm (Gr. *pseudēs*, false, and *plasma*, a thing moulded), a new growth or tumour.

Psoriasis (Gr. *psōra*, the itch), a chronic disease of the skin, distinguished by the presence of white scales on a red base; dry tetter.

Psorosperms (Gr. *psōra*, the itch; *sperma*, seed), a name for the sporozoa.

Pterygoid (Gr. *pteryx*, wing; *eidos*, shape), wing-shaped.

Ptomaine (Gr. *ptōma*, corpse), any of the toxic or poisonous substances resulting from the decomposition or decay of animal matter.

Ptyalin (Gr. *ptyalon*, saliva), a ferment found in saliva, having the property of converting starch into sugar.

Pubis (Lat.), the os pubis or pubic bone at the lower part of the abdomen and connected with the pelvis.

Pupa (Lat. *pupa*, a doll), the second stage of development from the egg of those insects which undergo complete metamorphosis; the chrysalis.

Pupil (Lat. *pupilla*), the round opening admitting light in the iris of the eye.

Purpura (Lat. *purpura*), an eruption of purple spots in the skin. **Purpura hæmorrhagica**, an aggravated form of purpura extending over the whole body.

Pylorus (Gr. *pylōros*, gatekeeper), the outlet or opening of the stomach into the duodenum.

Pyriformis (Lat. *pyrus*, pear; *forma*, a form), pear-shaped; a term applied to a muscle within the pelvis.

R

Racemose (Lat. *racemus*, a bunch of grapes), having a shape resembling a bunch of grapes.

Radius (Lat. *radius*, a staff, rod, spoke), one of the two large bones of the forearm; in the horse, a bone of the foreleg between the humerus and the knee.

Receptive (Lat. *recipere*, to receive), having the quality for receiving.

Rectum (Lat. *rectus*, straight), the posterior part of the large intestine.

Recurrent (Lat. *recurrere*, to run back), recurring, reappearing.

Reflex (Lat. *reflexus*, thrown back), applied to the action of a part upon the application of a stimulus to another and distant part.

Regurgitation (Lat. *re*, again; *gurgitare*, to engulf), an eructation or throwing back.

Renal (Lat. *renalis—ren*, a kidney), pertaining to the kidneys.

Repellent (Lat. *repellere*, to repel), having the power to repel morbid processes.

Rete mucosum (Lat. *rete*, a net; *mucus*, mucous), the lower layer of living cells in the epidermis.

Rhizome (Gr. *rhiza*, root), a subterranean stem having roots at its nodes and a bud at its apex.

Rugæ (Lat., wrinkles), foldings or creasings of an organ, as in the mucous membrane of the stomach, &c.

Rumination (Lat. *ruminare*, to chew the cud), the chewing of the cud, the returning of the food from the stomach and its remastication.

S

Saccharomyces (Gr. *saccharon*, sugar, and *mykēs*, fungus), a unicellular vegetable organism similar to the yeast plant.

Sacrum (Lat. *sacer*, sacred), a triangular bone composed of five pieces (vertebræ), forming a portion of the vertebral column (spine or backbone), and belonging to the pelvis.

Sagittal (Lat. *sagitta*, an arrow), referring to the suture uniting the parietal bones.

Sanguine (Lat. *sanguis*, blood), applied to an active, energetic disposition.

Sapid (Lat. *sapere*, to taste), capable of being tasted; having taste or savour.

Sarcinococcus (Lat. *sarcina*, a bundle), a name of round or ovoid bacteria dividing in three directions, producing cubic masses of various sizes.

Sarcolemma (Gr. *sarx*, flesh, and *lemma*, husk), the membrane that envelops a muscle fibre.

Sartorius (Lat. *sartor*, tailor), a long slender muscle situated on the inner and front part of the thigh.

Scaphoid (Gr. *scaphē*, boat, and *eidos*, shape), a bone of the knee.

Scarification (Lat. *scarificare*, to scarify), to puncture a swollen part with a sharp scalpel, to let out effused serum, blood, or gases.

Schneiderian membrane (from a German anatomist, *Schneider*), the membrane lining the nose.

Scirrhus (Gr. *skirrhos*, a tumour), a kind of cancer, a hard cancer.

Scleroderma (Gr. *sklēros*, hard, and *derma*, skin), a disease in which the skin becomes stiff and hard.

Sclerotic (Gr. *sklēros*, hard), pertaining to the outer white, opaque, coat of the eye.

Scrotum (Lat.), the pouch containing the testicles.

Scutiform (Lat. *scutus*, a shield), shield-shaped.

Sebaceous (Lat. *sebum*, suet, fat), pertaining to the fat-secreting glands of the skin.

Semiology (Gr. *sēmeion*, sign; *logos*, discourse), all that is known in regard to the symptoms of disease.

Sensory (Lat. *sentire*, *sensum*, to feel), a term applied to a class of nerves which transmit sensation to certain parts.

Septic (Gr. *sēptikos*, putrefying), relating to putrefaction.

Septicæmia (Gr. *sēptos*, putrid; *haima*, blood), a condition of the blood induced by the absorption of septic products.

Septum (Lat.), a partition or division wall separating one cavity from another.

Sesamoid (Lat. *sēsamon*, a kind of seed, and *eidos*, form), resembling a sesame seed, a term for small bones situated in tendons about joints, and others similarly situated.

Sinus (Lat. *sinus*, a curve, fold, or hollow), a hollow excavation, recess, or pocket in any structure.

Smegma (Gr. *smēgma*, a cleansing substance), the fatty substance secreted by the sebaceous glands of the prepuce.

Spasmodic (Gr. *spasmōdēs*), having the nature of a convulsion or spasm.

Spavin, a disease of bones in which an enlargement appears on the inner and lower part of the hock joint.

Specific (Lat. *species*, species; *facere*, to make), that which distinguishes a thing, or makes it of the species of which it is.

Specific gravity, the measured weight of a substance compared with that of an equal volume of another taken as a standard.

Spermatic (Gr. *spermatikos—sperma*, seed), relating to the semen.

Spermatozoa (Gr. *sperma*, semen; *zōon*, animal), the essential elements of fecundation.

Sphenoid (Gr. *sphēn*, wedge, and *eidos*, likeness), wedge-shaped, relating to the sphenoid bone, an important bone of the skull.

Sphincter (Gr. *sphinktēr*, *sphingein*, to squeeze), a muscle surrounding and enclosing an orifice such as the anus.

Spirillum (Lat. *spirillum*, a curl), a bacterium whose elements are curved, often forming a spiral of several turns.

Splint, applied to a bony excrescence on the canon bone of the horse.

Sporadic (Gr. *sporadikos*, scattered), applied to diseases which may spread, but which are not epidemic, and occur here and there.

Sporozoa (Gr. *spora*, seed, and *zōon*, an animal), a class of parasitic protozoa.

Squamous (Lat. *squamosus*, scaly, *squama*, a scale), a skin disease in which a scaly condition exists.

Staphyline (Gr. *staphylē*, the uvula), pertaining to the uvula or the palate.

Staphylococcus (Gr. *staphylē*, bunch of grapes, and *kokkos*, berry), a micrococcus of which for the most part the individual cocci in a culture are solitary.

Staphyloma (Gr. *staphylē*, bunch of grapes), a giving way or bulging of the cornea.

Steapsin (Gr. *stear*, fat), a ferment which resolves fats into glycerine and their corresponding fatty acids.

Stearin (Gr. *stear*, fat), a substance contained in fat and composed of stearic acid and glycerine.

Sterility (Lat. *sterilis*, barren), the condition of an animal or plant when it is incapable of reproducing itself.

Sterilize (Lat. *sterilis*, barren), to render sterile or barren; to destroy the vitality of germs and prevent their reproduction.

Stertorous (Lat. *sterture*, to snore), breathing with a snoring sound.

Stethoscope (Gr. *stēthos*, breast; *skopein*, to examine), an instrument through which the organs of breathing, and the heart and arteries, are examined as to their sounds.

Stomatitis (Gr. *stoma*, mouth; *itis*, inflammation), inflammation of the mouth.

Strangles (Gr. *strangalē*, a halter), an infectious disease of the air passages, especially of the nasal cavities, of the horse, ass, and mule, associated with a suppurative condition of the submaxillary and other glands.

Streptococcus (Gr. *streptos*, twisted; *kokkos*, a berry), a genus of microbes in which the cocci are arranged in strings or chaplets.

Streptothrix (Gr. *streptos*, twisted; *thrix*, the hair), an order of fungi the cells of which unite into simple or branching threads.

Stricture (Lat. *strictura*, *stringere*, to compress), an abnormal contraction of a duct or passage from external pressure, or as a result of inflammation or other changes.

Strumous (Lat. *strumosus*, *struma*, scrofula), having the nature of scrofula.

Styloid (Gr. *stylos*, pillar), resembling a slender cylindrical column.

Subcarpal (Lat. *sub*, under; Gr. *karpos*, the wrist), situated under the carpus or wrist; the wrist of the horse is spoken of as the knee.

Sublobular (Lat. *sub*, under; *lobulus*, a lobule), situated beneath a lobule.

Submaxillary (Lat. *sub*, under; *maxilla*, jaw-bone), lying beneath the lower maxilla or jaw-bone.

Sudoriparous (Lat. *sudor*, sweat; *parere*, to beget), producing or secreting sweat.

Suffrago (Lat. *suffrago*, hock), the hock; *os suffraginis*, the bone of the hock.

Supplemental (Lat. *supplementum*), applied to the air that can still be exhaled after ordinary expiration.

Suspensory (Lat. *sub*, under; *pendere*, to hang), a structure by which another part hangs.

Symbiosis (Gr. *syn*, along with, and *bios*, life), the intimate association of living organisms, one of which is necessary to the other.

Symbiotes (Gr. *syn*, with, *bios*, life), a small parasite infesting the legs of horses.

Sympathetic (Gr. *sympathētikos*, sympathetic), effecting sympathy or consentaneous activity.

Symphysis (Gr. *syn*, together, and *phycin*, to grow), a growing together, a union; especially, line of union of the two pubic bones, symphysis pubis.

Synarthrosis (Gr. *syn*, together, and *arthron*, joint), a form of joint in which the bones are immovably united together.

Syncope (Gr. *synkopē*, a cutting short), a swooning or fainting, a temporary suspension of the functions of respiration and circulation.

Synovial (Gr. *syn*, together, and Lat. *ovum*, egg), relating to the synovia, which is a lubricating liquid connected with a joint.

Synthesis (Gr. *synthesis—syn*, with; *tithenai*, to place), in chemistry, the formation artificially of a compound by combining its component elements.

Systole (Gr. *systolē*, contraction), the contraction of the heart and arteries, by which the blood is propelled along the vessels.

T

Tænia (Gr. *tainia*, a band), a flat parasite composed of a number of flat segments; a tape-worm.

Tænia echinococcus (Gr. *tainia*, a band; *echinos*, a hedgehog; *kokkos*, a berry), a tape-worm ¼ in. in length.

Tænia perfoliata (Gr. *tainia*, a band; Lat. *per*, through; *folium*, a leaf), a tape-worm composed of consecutive segments, increasing in size posteriorly, measuring 2 in. long and ⅜ in. wide.

Tænia plicata (Gr. *tainia*, a band; Lat. *plicare*, to fold), a tape-worm about 3½ in. long and ⅜ in. wide.

Tarsus (Gr. *tarsos*, tarsus), the instep of man, the hock of the horse.

Taxis (Gr. *taxis*, order; *tassein*, to arrange), the returning of a prolapsed structure, as a hernia or the uterus, by the hand.

Telegony (Gr. *tēle*, afar; *gonē*, offspring), the influence of a previous sire on the offspring of a subsequent one through the same dam.

Temperament (Lat. *temperamentum*), disposition, general character as regards acting and feeling; the predominance of one group of constitutional functions over others in an individual.

Tendo Achillis, the tendon of the gastrocnemius muscle connected with the heel; the tendon that is cut in hamstringing.

Tenotomy (Gr. *tenōn*, tendon; *temnein*, to cut), an operation of cutting a tendon to correct some deformity of the limb.

Tetanus (Gr. *tetanos*, *teinein*, to stretch), a continuous spasmodic contraction of muscles.

Tetrad (Gr. *tetra*, four), a group of four; a microscopic organism divided into four elements.

Therapeutic (Gr. *therapeutikos*, curing), pertaining to therapeutics or the art of healing; curative.

Thoracic (Gr. *thōrax*, thorax), pertaining to the chest and to certain organs contained within it.

Thrombosis (Gr. *thrombos*, clot), a clot of blood formed within the heart or blood-vessels, and causing an obstruction to the circulation.

Thrush, a parasitic stomatitis presenting diffuse white patches, also called aphthæ; a diseased condition of the horse's foot attended with a foul-smelling discharge.

Tidal air, the quantity of air taken in during quiet breathing.

Tourniquet (Fr. *tourner*, to turn), an instrument for controlling the circulation of blood in a blood-vessel by means of compression.

Toxic (Gr. *toxikon*, poison), poisonous, due to poisoning.

Trachea (Gr. *trachēia*, a windpipe), the windpipe, a cartilaginous and membranous tube extending from the larynx to the lungs.

Tracheotomy (Gr. *trachēia*, trachea, and *tomē*, cutting), removal of a portion of the trachea, or incision into the trachea.

Trapezoid (Gr. *trapeza*, a table, and *eidos*, form), one of the bones of the knee.

Traumatic (Gr. *traumatikos—trauma*, a wound), caused by a wound or injury.

Trichiasis (Gr. *thrix*, a hair), abnormal direction of the eyelashes, producing friction and inflammation of the globe.

Tricophyton (Gr. *thrix*, a hair, and *phyton*, a plant), a germ or vegetable organism, parasitic upon the hair —*Tricophyton tonsurans* is what causes ringworm.

Tricuspid (Lat. *tres*, three; *cuspis*, point), having three cusps; as the tricuspid valve in the aortic and pulmonary artery.

Trismus (Gr. *trismos, trizein*, to gnash), spasm of the muscles of mastication, locked jaw.

Trochanter (Gr. *trochantēr, trochos*, a wheel or pulley), the process of bone on the upper extremity and sides of the femur or thigh-bone.

Trochlea (Gr. *trochilea*, a wheel or pulley), a part having the nature of a pulley.

Trypsin (Gr. *tripsis*, a rubbing), a substance which converts proteids into peptones; the ferment of pancreatic juice.

Tuber (Lat. *tuber*, a bump or swelling), a thickened portion of an underground stem, as the potato.

Tuberculin (Lat. *tuberculum*, a tubercle), a glycerine extract of cultures of the *Bacillus tuberculosis*.

Tuberculosis (Lat. *tuberculum*, a tubercle), the infectious disease corresponding to what is commonly called consumption, and due to *Bacillus tuberculosis*, discovered by Koch in 1882.

Turbinated (Lat. *turbo*, a top), top-shaped.

Tympany (Gr. *tympanon*, drum), distension of an organ or part with gas.

Tyrosus (Gr. *tyros*, cheese), a substance occurring in pancreatic digestion, a decomposition product of proteids.

U

Ulna (Lat., a cubit), the small bone of the forearm or horse's foreleg, its companion bone being the radius.

Umbilicus (Lat.), the navel.

Ungulate (Lat. *ungula*, a hoof), having hoofs.

Urea (Gr. *ouron*, urine), the chief solid constituent of the urine.

Urethra (Gr. *ourēthra*, urethra), the canal extending from the bladder to the end of the penis, through which the urine is discharged.

Urticaria (Lat. *urtica*, a nettle), nettlerash, a disease of the skin characterized by wheals.

V

Vaccinia (Lat. *vacca*, cow), cowpox.

Valvulitis (Lat. *valvula*, a small valve; *itis*, inflammation), inflammation of the valves of the heart.

Varicose (Lat. *varix*, a varix), showing varices or dilatations; abnormally dilated, as a vein.

Vegetations (Lat. *vegetatio, vegere*, to grow), a name applied to morbid growths, such as abnormal granulations, excrescences, warts, &c.

Vena cava (Lat. *vena*, vein, *cavus*, hollow), a name for the two large veins entering the heart.

Ventricle (Lat. *ventriculus*, dim. of *venter*, a belly), the name for the two lower cavities of the heart.

Vertigo (Lat. *vertere*, to turn), giddiness, dizziness.

Vesicle (Lat. *vesica*, bladder or blister), a small blister-like formation.

Vibrio (Lat. *vibrare*, to vibrate), a genus of Schizomycetes similar to Spirillum.

Virus (Lat.), a poison that causes a morbid process or disease; any pathological microbe.

Vitreous humour (Lat. *vitrum*, glass; *humor*, fluid), the transparent gelatin-like substance that fills the posterior chamber of the eye.

Volition (Lat. *volitio*, will), determination to act; a willing to do or not to do something.

Vomer (Lat., a ploughshare), the bone situated in the middle of the nostrils.

Vulva (Lat.), the female pudendum, or posterior part of the genital passage.

X

Xiphoid (Gr. *xiphos*, sword; *eidos*, like), sword-shaped; applied to the flat piece of cartilage behind the sternum.

Z

Zygomatic (Gr. *zygōma*, zygoma), pertaining to the zygoma or cheek-bone.

INDEX

A

Abdomen or Belly—
Breathing peculiar to pleurisy, ii, 14, 15.
Conformation and defects, i, 3, 16, 17, 62, 91, 102; cavity and muscles, ii, 338, 341; pancreas and tunic, i, 241; ii, 335.
Distension or swelling, i, 283, 290, 292, 303, 309, 311, 316; ii, 13, 25
Drugs for disorders, ii, 462, 464–468; iii, 3.
Hemorrhage symptoms, i, 502.
Muscles, ii, 335–338; respiratory uses, i, 492; rupture, i, 324.
Nerves—distribution, i, 377.
Pain—disorders indicated by, i, 270, 272, 274, 275, 278, 279, 281, 282, 288, 289, 290, 291, 293, 350, 471
Poulticing and mustard plasters, iii, 32, 33.
Pregnancy and parturition—signs, &c., iii, 264, 269, 272.
Rings, abdominal—form, &c., i, 17; ii, 95, 97; hernia treatment, i, 319, 320, 321, 323
Show-horses' "let down" belly—treatment, iii, 310, 311.
Tendons—forms, &c., i, 366.
Testicles in cavity—castration, &c., iii, 186–188
Tuberculosis affecting lining of, ii, 51.
[See also Stomach; for special disease, see its name.]

Abdominal aorta—formation, i, 451.

Abdominal ascites or dropsy—see Ascites).

Abducentes—nerves from brain, i, 385.

Abductor muscles—action, &c., ii, 396.

Aberdeenshire Clydesdales—origin, &c., i, 109.

Abortion—causes and treatment, iii, 267–269; drugs, ii, 463, 475. Show horses, iii, 216; various influences, ii, 80; iii, 208, 209, 216, 217.

Abscesses—
Antiseptics and astringents for, ii, 421, 434
As symptoms of—bone and joint diseases, ii, 209, 211, 213, 282, 283; capped elbow, knee, and hock, ii, 359, 361, 362, 363, 364; epizootic lymphangitis, ii, 59, 60, 62; facial paralysis, i, 423; fistula of parotid duct, &c., i, 250, 270, 301; heart disease, i, 464; kidney disease, &c., i, 314, 315; liver inflammation, i, 305, 309; mammary glands and udder, ii, 53, 95, 96; penis and testicle, ii, 81, 86; pyæmia, i, 509, 481, 482; spinal inflammation, i, 418; strangles, ii, 40, 41, 69; tetanus, ii, 46; throat affections, i, 255, 256, 257; thrombosis of jugular vein, i, 476, 477; tongue inflammation, i, 253; ventral hernia, i, 325.

Abscesses—(*Cont.*)
Forms and causes—brain and poll evil abscesses, i, 409; ii, 431; eyelids, ii, 112; feet, ii, 375, 379, 380; shoulders, ii, 433, 434; speedy cutting, ii, 491; withers, ii, 435, 436.
Pointing of abscess—description, i, 261; ii, 431.
Pressure and wound-poisoning causing, i, 220; ii, 406, 410.
Pus in urine due to, i, 344
Sinuses communicating with, ii, 428, 433.

Absorbent System—
Definition and use, i, 425, 426.
Skin action and uses, ii, 128–130.
Structure, &c., of lacteal and lymphatic system and glands, i, 426–430; blood corpuscles formation, i, 433.

Acari—diseases due to, ii, 142, 163.

Acariasis and its treatment, ii, 166–168.

Accelerating nerves of heart, i, 441

Accelerator urinæ muscle of penis, ii, 70, of urethra, ii, 72.

Accessory flexor muscle of foot and pastern, ii, 345

Accidental dislocations—causes, &c., ii, 346, 349

Accidents first aid and articles, ii, 437–441; pregnancy, iii, 266–269; rupture, i, 475, 315; shipboard horses, iii, 463; warranty laws, iii, 417, 418, 425. (See also Poisons.)

Acetabulum form and pelvis connection, i, 83; ii, 192; fracture of, ii, 257, 258, 259.

Acetate of various drugs—medicinal uses of ammonia, ii, 469, 472; of ammoniuni, ii, 459; iii, 7, 10; lead, iii, 1, 9; morphine, iii, 9; potash, ii, 445, 462; zinc, iii, 456.

Acetic acid—medicinal uses, iii, 1; poisoning by, iii, 52.

Acidity of stomach—remedies, ii, 440, 460.

Acids—
Antiseptic and astringent properties and forms, ii, 420, 421, 434, 435.
Blood composition, i, 438.
Digestion and foods—production of acids, i, 235, 243.
Medicinal preparations, ii, 449, 470, 475, 465; iii, 9; antidote uses, iii, 45.
Stone in bladder—solutions, i, 360

Aconite—medicinal uses, ii, 451, 461, 469, 471, 472; doses, iii, 10, 11; poisoning and antidote, iii, 57, 63, 64.

Aconitine—medicinal uses, ii, 461.

Acorns—poison by, &c., iii, 104, 105, 106

Acquired dislocation form, &c., ii, 349.

Acquired rupture classification, &c., i, 315.

Actinomyces in food causing disease, iii, 103.

Actinomycetes description, ii, 161.

Action in breach of warranty, &c.—course to follow, iii, 425, 426.

Action of a horse—
All action and no go, i, 122
As symptom of blindness, ii, 123; bone diseases, ii, 206, 207, 208, 210; curb, ii, 301; fractures, ii, 244, 245, 257, 258, 262; indigestion, i, 270; lamintis, ii, 377; sprains, ii, 294, 297, 299; stone in bladder, i, 357.
Breeds—Cleveland bays, i, 132, Clydesdales, i, 70, 102, 103; hackneys, i, 121–123, harness horses, i, 151, 152; hunters, i, 140; Holsteins, i, 200; Oldenburghs, i, 208, 209; jack horses, i, 123, ponies, i, 100, 101, hackney and Welsh ponies, i, 170, 171; saddle horses, i, 147, 148; Shires, i, 70, 184; Suffolks, i, 194, 199, 200, Yorkshire coach horses, i, 134
Carriage of head and neck, i, 46, 47, 49.
Cart-horse drawing a load, i, 68, 88
Conformation of various parts affecting action, i, 56, 59, 60, 69, 71, 72, 73, 74, 82, 83, 84, 85, 86; ii, 197
Defective action and injuries from (see that title).
Examination as to soundness, iii, 374
High action—forearm structure, i, 72; diseases due to, ii, 310, 391, 400.
Muscles affecting, ii, 200, 329, 343.
Show horses training, iii, 311–313.
[See also titles Galloping, Locomotion, Shoulder Action, Trotting, &c.]

Action of muscles names according to, and description of actions, ii, 396

Actionable fraud or misrepresentation in sale of horses, iii, 405, 409–411, 413, 420

Acute diseases definition, i, 213.

Adductor muscles distinction, ii, 396; parvus and magnus forms, ii, 341, 342

Adenoid tissue of absorbent system, i, 429.

Adhesion of wounds—methods of healing, ii, 404–406.

Adulterated food disease by, i, 221 linseed and cake food, iii, 115

Adventitia of arteries, i, 441.

Æstrum or heat, i, 18, iii, 247, 262, disorders and causes, i, 471, 479, ii, 61, 63; iii, 265, troublesome mares, iii, 195–201, drugs, iii, 13.

Afferent nerve-fibres form, i, 387.

Afferent nerves—description, i, 374.

African horses—history, &c., iii, 525, 527, 529, 531–535.

After-birth formation, iii, 251, 253; removal and disconnection from foal, iii, 270, 272, 274; in hemorrhage, ii, 82.

Age of a horse
Birthday and other guides, iii, 304; form of back, i, 56, 58; nose and eye, i, 9, 11. (See also Teeth.)
Castration considerations, iii, 172.

Age of a horse— *Cont.*
Disease and fractures influence, i, 214, 218; ii, 223, 236, 279, 285.
Longevity of breeds, i, 197, 198, 200, 206, 207.
Medicinal doses according to, iii, 12.
[See also title Old Horses.]
Agents in sale of horses—warranty regulations, &c., iii, 414–417.
Agricultural or farm horses—
Breeds and their merits Cleveland bays, i, 128, 129; Clydesdales, i, 180, 182; East Friesland horses, i, 210; hackneys, i, 113, 114, 118; Percherons, i, 205; Schleswig breed, i, 210; Shires, i, 172, 181; Suffolks, i, 194, 197, 198, 199, 200.
Classification as heavy horses, i, 172.
Disease due to occupation, i, 210
Food—composition and amount, &c., iii, 89, 90, 347; indifferent feeding, i, 277.
History on non-use of the horse, iii, 521, 524, 528, 529, 538.
Overgrowth of hoofs, iii, 436.
Royal interest in breeding, i, 173.
Working mares during suckling, i, 287
[See also title Draught Horses.]
Ailments classed as unsoundness and vices—list, &c., iii, 420–426.
Air and Atmosphere—
Air-pressure borne by horse and man, i, 488
Amount per horse, iii, 76, 78, 79; sick horses, iii, 142.
Breathing uses, i, 487, 493; after respiration, i, 488, 493; changes in blood due to air, i, 489–491; entrance into lungs, i, 483, 484
Composition of air, i, 487, 493; bacillus, i, 228; examination, iii, 132, 135.
Contamination due to stable and breathing influences, iii, 76–78, 79.
Disease due to impure air, &c., i, 213, 214, 216, 222, 478; ii, 11; iii, 152.
Ventilation of stables, &c., i, 495–497; iii, 329, 331.
Air-cells—respiratory uses and formation, i, 486, 487; dilation, ii, 12
Air-passages—drugs for, ii, 468–470; iii, 14; stimulant and soothing remedies, ii, 470–472; irritation causing pneumonia, ii, 7.
Alæ—coffin-bone, ii, 200; nostrils, i, 9.
Albumen—astringents coagulating, ii, 448, 454, 455; presence in urine, analysis, &c., i, 345; ii, 26–29, 31.
Albuminoids of body and in food, iii, 87, 88, 89; digestibility, iii, 91, 92, 96, 98; heat influence, &c., iii, 100.
Alcohol blood vessels, effect on, ii, 462; medicinal uses, ii, 451, 462; iii, 25; poisoning and antidote, iii, 50, 52, 56, 57, 64.
Ale for mares after foaling, iii, 227.
Alfalfa causing poisoning, iii, 62.
Alfred the Great—horse breeding, iii, 536, 537.
Algæ in water, iii, 127–129
Alimentary Canal—absorbent system connection, i, 425; progress of food through, i, 240, 247 see also Digestion.
Alkaline in intestinal digestion, i, 245, 249
Alkaline preparations—for digestion, ii, 467, 472; for lungs, ii, 469
Alkalinity of the blood—drugs for reducing, ii, 448–450
Allah—creation and care of the horse, iii, 518, 533
Allantoid sac—formation, iii, 251
Allantois membrane—formation, iii, 250, 251.
Almaine horses—type, i, 175, 176, 177.
Aloes—uses and doses, iii, 1, 9; for show horses, iii, 311, preparation and giving of ball, ii, 444, 445.
Aloin—medicinal uses, iii, 1; doses, iii, 9
Alteration of structures—explanation of term in warranty, iii, 419.
Alteratives as medicine—action and examples, ii, 12, kinds acting on tissue change, ii, 452–454; mercury uses, ii, 489; prescriptions for balls or powders, ii, 15, 16, show horses, iii, 311.
Alternate generation—process of, &c., iii, 259–261, 450.
Alum medicinal uses, &c., ii, 439, 455, 456; iii, 1—dose, iii, 9; solution for sores, i, 248.
Alumina—compounds used in medicine, ii, 455, 456.
Aluminium—medicinal uses, ii, 454.
Alveoli—of lungs, i, 480, of teeth, ii, 186; effect of fractured teeth, i, 330.
Amaurosis—causes and detection, ii, 122, 123; iii, 51.
Amber tinge in eye, ii, 116, 117.
Amble—form of motion, iii, 195, 197.
Ambulance—first aid directions, &c., ii, 437, 439, 441
American boil—treatment, ii, 150, 151.
American horse-pox or disease—nature, &c., ii, 142, 150, 151.
American horses—breeding and importation, i, 153, 196, 207, 208; fossil remains and history, iii, 510, 550; illusts., iii, 314, training and treatment, i, 330; iii, 313–316; water-supply, iii, 302 see also Trotters).
American "pink-eye"—nature, ii, 31.
Ammonia and Ammonium—medicinal uses, i, 263; ii, 459, 460, 477; iii, 3, 7; doses, 9, 10; poisoning by and antidote uses, iii, 52, 56, 57, 64
Amnion membrane—formation, iii, 250, 251
Amœba—formation, diseases due to, and evolution, ii, 161; iii, 258.
Amphiarthrosis joints—form, &c., ii, 269, 270.
Amputation of penis, ii, 83, 85.
Amyl, nitrite of—medicinal uses, ii, 457, 474.
Amylolytic action in digestion, i, 244.
Amylopsin in digestion, i, 246.
Anæmia and its treatment, &c., i, 478–480; ii, 159; heart sounds in, i, 459.
Anæsthesia local and general, ii, 479; recovery means, ii, 449.
Anæsthetics and their uses, ii, 450, 479; iii, 12, 169; for nervous system, ii, 479–483.
Anaphrodisiacs—medicinal uses, iii, 12.
Ancestors of the horse—fossil remains and origin, iii, 475, 500–513; from five- to one-toed foot, iii, 480, 491; head and teeth formation, iii, 442–495; marks and colouring, iii, 497–500 see also titles Back-breeding, Evolution, History of the Horse, Pedigrees, Telegony.
Anchitherium—fossil remains of, iii, 512.
Anchylosis—causes, &c., ii, 281, 431.
Ancient Britons horses used by, i, 154, 172, 179; iii, 535
Anconeus muscle—form, &c., ii, 330.
Andersch's ganglion on cranial nerve, i, 395.
Aneurism—causes and results, i, 474, 473, 474, 477, 478; ii, 174
Angina pectoris in horses, i, 469; drugs for, ii, 463.
Angle of the ilium—fracture, ii, 256–259
Animal body—composition of, iii, 87.
Animal matrix in bone, ii, 175
Animal remains in earth's crust, iii, 471, 472.
Animal world—the horse and its position in, iii, 471–513
Animals Act—transit regulations, iii, 466, 497
Animals and evolution, iii, 286, 287.
Aniseed—medicinal uses, ii, 474; iii, 1; doses, iii, 9.
Annular cartilage of ear, ii, 310.
Anodynes and their uses, i, 290, 294, 313; ii, 21, iii, 12.
Antacids and their uses, ii, 449, 450; iii, 12.
Anterior aorta—form, &c., i, 448, 449.
Anterior crural nerve—form, i, 402.
Anterior deep pectoral muscle—nerve to, and form of, i, 399; ii, 327.
Anterior extremity of body, i, 16.
Anterior gluteal nerves—formation, i, 403.
Anterior ligament of hock, ii, 278.
Anterior limb—see Fore Limb
Anterior maxillary bones—form, ii, 189; fracture, ii, 242
Anterior mesenteric artery—diseases of, i, 471, 477; ii, 174, distribution of, i, 448.
Anterior radial artery—form, i, 449.
Anterior surface of head, i, 8–10.
Anterior tibial artery—form, i, 453
Anterior tibial nerve formation, &c., i, 404, 405.
Anthelmintics and their uses, iii, 12, 13; for worms, ii, 465, iii, 16, 17, poisoning by vermin-killers, iii, 49, 53, 57, 58.
Anthrax and its treatment, &c., ii, 41–43; iii, 151; of glosso-anthrax, ii, 43, 44; contagion and bacteria causing, i, 223, 224, 225, 226; food contamination, i, 221; horse sickness similarity, ii, 54.
Antidotes to poisoning—action and examples, iii, 45, 46; gastritis, i, 275; mercury, want of antidote, ii, 489; vomition difficulty preventing use of, i, 275 (for special poison, see titles Arsenic, Lead, &c.).
Antifebrin—medicinal uses, ii, 450
Antihydrotics—action and examples, iii, 13.
Antimony and its uses, ii, 453; 471, 472; poisoning by, iii, 50.
Antiperiodics and their uses, iii, 13
Antipyretics or febrifuges—their uses, &c., ii, 448, 450–452, 483; iii, 13.
Antipyrin—medicinal uses, ii, 450.
Antiseptics—action, lists, &c., ii, 420–422, 483–488; iii, 13, 174; common articles used, ii, 429, Lister's system, ii, 407, 411; operations, iii, 162, 163, 171, 181, 182, 185; uterine hemorrhage, ii, 80, wounds and ulcers, ii, 386, 407, 411, 420–422, 427
Antispasmodics and their uses, ii, 479; iii, 13.
Antitoxic serum for tetanus, ii, 40.
Anti-vivisection Act—knowledge of drugs retarded by, ii, 443.
Anus—formation and muscles, &c., i, 15, 229, 238; worms and bot-flies infesting, ii, 169, 171.
Aorta—construction and uses, i, 438, 442, 448, 449, 451; diseases, i, 465, 471, 472; origin of other arteries, i, 448; sounds connected with, i, 449, 460.
Aortic arch—formation and disease, i, 451, 472
Aortic sigmoid—sound due to tension of, i, 449.
Aortic valves—disease, i, 465, 471, 472.
Aperient medicines—abuse of, ii, 442 see also Purgatives).
Aphrodisiacs and their uses, iii, 13.
Aphthæ and its treatment, i, 250–252; drugs used, iii, 2, 3, 5.

Aponeurotic tendons and connections, ii, 306, 323, 335.
Apophyses of bone—formation, ii, 178.
Apoplexy and its treatment, i, 412; other causes, i, 220, 222, 308; heart affected by, i, 457.
Appetite—disorders affecting, i, 272, 276; ii, 6; drug improving, ii, 451; food inducing, iii, 94, 140–142; poisoning symptoms, iii, 47.
Appliances— see Instruments.
Aqueductus sylvii of brain, i, 384
Aqueous humour of eye—formation, ii, 105, 107; glaucoma causes, ii, 123.
Arab horses and blood—
Ancient pedigrees, "families", and history, i, 201, 202; iii, 518, 519, 524, 525, 528, 530, 531–535.
Belief on creation, and care by Arabians, iii, 518, 533.
British thoroughbreds — origin and crosses, i, 200, 203; iii, 538, 540, 544, 546, 549, 550.
Conformation, colour, and merits, i, 40, 201–205.
Crosses — Cleveland bays, i, 124, 128; hunters and saddle horses, i, 138, 141, 148, 149; Percherons, i, 205; ponies, i, 163, 165, 166.
Desertion by breeders, i, 200, 201, 203.
Illustrations, i, 294; ii, 412; face form, i, 40.
Stud inspected by Lady Blunt at Hail, i, 202, 203.
Arachnoid of brain and spine—formation, i, 380, 384.
Arbor vitæ of brain, i, 385.
Arch of vertebræ—fracture, ii, 235.
Arched back—appearance and defect, i, 57; fever causing, ii, 98.
Arched crest—appearance, i, 28.
Arched face—appearance, i, 41.
Arched neck—appearance, &c., i, 45, 47, 48.
Architecture of stables—(see Stable).
"Ard Patrick"—thoroughbred (illust.), i, 108.
Areca nut—dose, iii, 9.
Arm—(see Forearm).
Armadillo—horse-origin and history, iii, 497, 499
Armour carried by old war-horses, &c., i, 175; iii, 542, 543, 545.
Armoured mammals—origin of marks from, iii, 497, 499.
Army horses— see titles Cavalry, Military, War.
Arnica—medicinal uses, iii, 1; doses, iii, 9.
Aromatic spirit of ammonia—stimulant uses, ii, 450; dose, iii, 9.
Arseniates of iron and copper—medicinal uses, ii, 447, 453, 472; iii, 1; doses, iii, 9.
Arsenic—as caustic, ii, 143, 155; medicinal uses, ii, 453; iii, 1, 2, 9; for various diseases, i, 500; ii, 14, 148, 431; poisoning by, and antidotes, ii, 448; iii, 48–50; gastritis due to, i, 274.
Arsenious acid and oxide—medicinal uses, ii, 453; iii, 1, 2; doses, iii, 9.
Arteria innominata—formation, i, 449.
Arterial blood—composition, &c., i, 489.
Arterial circle—"circle of Willis", formation, i, 451.
Arterial hemorrhage—causes, &c., i, 501, 502.
Arteries and veins—
As organs of circulation—formation, &c., i, 441–444.
Capillaries and connections, i, 446.
Chief arteries and veins and their distribution, i, 447–453.
Cold and heat effects, iii, 136.
Arteries and veins— *Cont.*
As organs of circulation— *Cont.*
Systemic arteries — distribution and names, i, 448–453.
Bleeding from—arrest, &c., i, 501–503; ii, 400, 437–439 see also title Bleeding or Hemorrhage.
Diseases—aneurism, i, 477; arteritis and atheroma, i, 471–473; heart disease detection, i, 452; thrombosis—iliac, and of jugular vein, i, 473–477 see also Blood Diseases.
Embryo and fœtus formation, iii, 255–257.
Of various organs, distribution, &c.—bladder, i, 317; bones, ii, 176; eye, ii, 103; limbs, i, 300, 302; liver, i, 249, 249; testicles, &c., ii, 66, 67, 70.
Pulse movement, &c., i, 443; iii, 146–148.
[For special artery or vein see its title, as Aorta, Jugular Vein, &c.]
Arteritis of arteries—treatment, i, 471.
Arthritis or joint-ill—forms of disease, ii, 285–288; origin of joint disease, ii, 280; symptoms of liver inflammation, i, 306; of pneumonia, ii, 7.
Arthrodia joints—form of, ii, 263.
Arthropedes—forms of parasites, ii, 163.
Articular angles of hind limb, i, 83, 84.
Articular cartilage of knee, ii, 197.
Articular foramen in bone structure, ii, 176, 178
Articular processes of vertebræ—ligament and muscle connections, ii, 265, 324.
Articular wind-galls—form, &c., ii, 355.
Articulations see Joints, Joint diseases, Sprains—special joint, see its name
Artificial grasses hay made from, iii, 111
Artificial insemination—process of, iii, 231–234
Artificial ventilation of stables, iii, 74–76.
Artificiality in show horses, iii, 313.
Artiodactyla or even-toed animals, iii, 476, 477.
"Artist"—chestnut hunter (illus.), ii, 456.
Arytenoid cartilages—formation, &c., i, 485; ii, 317
Arytenoid muscles—forms, &c., ii, 317
Arytenoideus muscle—form, &c., ii, 317.
Asafœtida—medicinal uses and dose, iii, 2, 9.
Ascarides—infesting intestines, ii, 170, 171; drugs destroying, iii, 8.
Ascites, abdominal—causes, treatment, &c., i, 307, 309, 310–312.
Ascococcus formation, &c., i, 226.
Ascot Races—founder of, i, 111.
Aseptic probe for wounds, ii, 414
Aseptic treatment of wounds, ii, 408, 409, 411, 414; sponges, &c., used in dressing, ii, 415.
Ash in body and food, iii, 87, 89.
Asia—history of horses of, iii, 531–535, British crosses, iii, 549.
Asphalt for coach-house floors, iii, 334.
Asphyxia—causes, &c., i, 404, 507.
Asses—ancient uses, iii, 519; glanders, ii, 35, 38; horny growths, chestnuts, &c., iii, 478, 496, 504, 506, 507; stomach worms, ii, 169; "stone" in, i, 355.
Association, a form of parasitism, ii, 160.
Asternal ribs—formation and respiratory use, i, 402
Asthma and its treatment, ii, 11; drugs for, ii, 463, 472; iii, 3, 5.
Astragalus—structure, i, 80, 87; ii, 263; iii, 477, muscles connected, ii, 344.
Astringents—acting on tissue change, ii, 454 457; action and examples, iii, 13; iron uses, ii, 447; prescriptions for powders, &c., iii, 15, 16, 18.
Athelstane and horse-breeding, iii, 537.
Atheroma—symptoms, &c., i, 472, 473
Atlas bone—form, &c., ii, 180, 181, 265, 269, muscle connections, ii, 322
Atlo-axoid articulation form, &c., ii, 268, 269
Atmosphere— see Air.
Atrophy—of heart, i, 467, of muscles due to sprained back, ii, 298, of skin, ii, 155; of udder, ii, 95
Atropia and atropine medicinal uses, ii, 478, 480, 481.
Attendants on sick horses—duties, &c., iii, 2, 3, 141, 154.
Attitude a sign of disease, iii, 145
Auctioneer—warranty and the sale of horses, iii, 415, 416.
Auditory canal—formation, ii, 185
Auditory nerves—formation, &c., i, 385, 395.
Auricles of heart—growths causing disease, i, 464, rupture, i, 470, structure, i, 438.
Auriculo-ventricular valves—contraction, &c., i, 439, 440.
Auscultation for detection of bronchitis, ii, 2; congestion of lungs, ii, 6; heart disease, i, 454, 455, 460; horse sickness, ii, 56, pleurisy, ii, 14.
Axe, Prof.—on hæmoglobinuria, ii, 26–29; meningitis, i, 423, 424, seedy toe, ii, 370, 371, transit and tethering of horses, iii, 464, water in animal tissues, &c., iii, 124, worms and parasites, ii, 164.
Axillary artery—formation, &c., i, 449; ii, 322
Axillary nerve—formation, i, 491
Axillary region muscles and nerves connected with, ii, 322, 327.
Axis or dentata bone and joints, ii, 180, 181, 265, 268, 269; muscle connections, ii, 320.
Ayrshire Clydesdales—origin, &c., i, 160.
Azoturia—analysis of urine and moisture in tissue due to, ii, 27, 28; Epsom salts uses, iii, 4; use of term, ii, 29.

B

Bacilli—description of, i, 226, of abortion, ii, 80; anthrax and horse sickness, i, 225, 226, 228; ii, 41, 42, 54, epizootic lymphangitis, ii, 59, 60, food, hay, and digestion, i, 225, 228, 246; glanders, ii, 34, 35, 37; tetanus, diphtheria, and wounds, i, 227; ii, 46, 412; tuberculosis, ii, 50, 51.
Back— see titles Spine and Back, Spinal Diseases and Injuries
Back-breeding influences and opinions on, iii, 211, 212, 213, 239–245, 480, 497, 499, 513
Back-raking—directions, iii, 34.
Back tendons—operation on, iii, 161, 171; soundness and warranty, iii, 379, 423.
Backing of horses—examination for, iii, 374.
Bacteria as cause of disease, i, 227–229; causing anthrax, ii, 41, 42, blood-poisoning, i, 481, tetanus, ii, 46, ulcers, ii, 427, 428, discoveries on and forms of bacteria, i, 224–226, wounds affected by, and disinfection of instruments, ii, 406, 407, 412, 415.
Bad doers—weak digestion, iii, 119
Bad habits—as stable vices, iii, 341–343.
Bael fruit—medicinal uses, iii, 2
Baker's horses liable to "stone", i, 300.
Bakewell era of heavy horse breeding, i, 172.
Ball-and-socket joints—form, &c., ii, 262

Balling "iron" and "gun" for giving physic, iii, 20

Balls of physic—faith in, ii, 442; for bitter tonics, ii, 466; for conditioning, ii, 445, 446; preparation and administration, ii, 444–446; iii, 19–21; prescriptions, iii, 15, 16; use of arsenic in, ii, 453

Balsams of Peru and Tolu—medicinal uses, ii, 469, 471.

Balsams of sulphur, &c.—uses, ii, 474.

Bamboo as fodder, iii, 26.

Bandages—
- Accidents—useful articles in, ii, 438, 439.
- Application and preparation, iii, 36–38.
- Bone diseases treatment, ii, 206, 208, 218
- Fractures—fore-leg, ii, 231–234; humerus, ii, 244, 245; jaw, ii, 242; knees, ii, 247, 423; metacarpal bones, ii, 249; pastern, ii, 250; radius, ii, 247.
- Horses tearing—correction, iii, 341.
- Hunters and muddy legs, iii, 136, 310
- Sick horses warmth, iii, 143.
- Sprains, wounds, &c., ii, 220, 291, 296, 357, 389, 418
- [See also Poultices.]

Barbary horses—origin and history of the "Barb", iii, 525, 528, 530–535. British thoroughbreds, crosses, &c., iii, 538, 539, 544, 546, 549, 550.

Bare patches of skin—formation of chestnuts, &c., iii, 504, 506.

Bar-iron—prepared for shoeing, iii, 445.

Barley as food—composition and preparation, i, 241; iii, 89, 107; digestibility, &c., iii, 97, 99, 342; invalid diet, iii, 22.

"Barley Harvest" family of Cleveland boys, i, 129

Barley straw—as food, iii, 112; for bedding, iii, 355.

Barley-water—as antidote, iii, 45.

Barrenness—see Sterility

Bars of foot—corn on, and cutting of bars, ii, 374, 394; iii, 435, 445; structure, iii, 434.

Bars of jaw—abuse by bunning, i, 284; structure, disease, &c., i, 6; iii, 494; purist mouth effect, i, 332.

Barton-Gillette clipping-machine, iii, 117

Bartrum's tethering apparatus—use, &c., iii, 405, 406

Basilar process of occiput bone, ii, 184

Bastard strangles in old horses, ii, 40.

Bay colour Arabs, i, 95; Morgans, i, 207; Suffolks, i, 165, 170; origin of "clapping", iii, 495; see also Cleveland Bays.

Beak of ulna—formation, ii, 196.

Beans—composition and use as food, iii, 89, 112–114, 345, 349; digestibility, iii, 96, 98, 99, 100; diseases due to, ii, 152

Bean-straw as food, iii, 88.

Bearing-rein—abuse and use, iii, 353; diseases due to, i, 511; ii, 430

Beat of heart—medicines aiding, ii, 458, 462; testing pulse, iii, 140–142.

Bedding—eating by horses, iii, 130, 208, 265, 341; infectious diseases, iii, 154, materials used, iii, 118, 129, 354–357; pregnant mares, iii, 205, 265; sick box, iii, 24

Bed-sores—prevention, ii, 237

Bees poisoning by stings of, &c., ii, 414; iii, 61.

Bees'-wax—fracture uses, ii, 241.

Beetroot—as invalid diet, iii, 27.

Belgic stallions—breeding from, i, 178.

Belladonna—medicinal uses, ii, 473, 474, 475, 476, 481; iii, 2, doses, iii, 10, 11, for lungs and cough, ii, 470, 471, 472, for other diseases, i, 206, 294, 297, 347, 561; to reduce temperature, ii, 451; poisoning by, iii, 55.

Belly—(see title Abdomen)

Benzoic acid—medicinal uses, iii, 2, 9.

Benzoin—medicinal uses, ii, 469, 471.

Bicarbonate—medicinal uses of potash, ii, 448, 472; potassium, iii, 2—doses, iii, 9; of soda, ii, 449, 459, 472; sodium, iii, 2—doses, iii, 9

Biceps femoris muscle—form, &c., ii, 340; fracture and dislocation effects, ii, 245, 351

Biceps of man—flexor brachii muscle form, ii, 329.

Bichloride of mercury—uses, ii, 488.

Bicipital groove—form, &c., ii, 194, 195, 329; sprain effect, ii, 293.

Bicuspid valve of heart, i, 438

Big head disease—symptoms, &c., ii, 214–216.

Bile and bile-ducts—drugs affecting, ii, 465; iii, 13; formation and digestive uses, i, 240, 245, 246; liver disorders due to, i, 301, 304, 305, 309, 397; parasitic influences, i, 313, 314, secretion causing constipation, i, 284, urine affected by, i, 343.

Bilious temperament—disease disposition, i, 218.

Biniodide of mercury—uses, ii, 422, 488, 489.

Bioplasm of parasites, ii, 161.

Birthdays—age and teeth tests, iii, 393.

Births—see Foals, Parturition.

Bishoping of teeth, iii, 393

Bismuth—medicinal uses, i, 280; ii, 457

Bistoury for lithotomy, &c., i, 362, 380.

Bites—rabies due to, ii, 14

Biting—vice and warranty, iii, 424.

Bits—care and kinds of, iii, 357–359; diseases and trombles due to, i, 151, 152, 248, 252, 258, ii, 209, 213; jumping influence, iii, 202; use in horse-training, iii, 301, 303—hunters, iii, 307, 308, 369, 311, 312—trotters, iii, 314

Bitter tonics for stomach, ii, 466, 478.

Black antimony and sulphur—medicinal uses, iii, 15, 17.

Black horses—early types and origin, i, 178; iii, 543.

Blackleg disease—inoculation, iii, 151

Black pepper—medicinal uses, iii, 2, 9

Black spots on eye—causes, &c., ii, 117; iii, 209.

"Black Vulcan" price and honours, i, 18

Bladder
- Contormation, nerves and urinary uses, i, 333, 336, 337; female, ii, 74, 76; embryo, iii, 253.
- Disorders of, and affecting bladder—bloody urine due to hemorrhage, i, 347; fistula, ii, 420; inflammation, i, 340; inversion, i, 371–373; irritation, i, 344; retention of urine, i, 352; rupture, i, 343, spinal myelitis causing distention, i, 410; tumours, i, 357; ulceration, i, 360; Vesiculæ seminales, ii, 63; stone in the bladder (see that title).
- Drugs acting upon, ii, 473–475, 481.
- Emptying by catheter, washing out, &c., i, 362, 363; ii, 220; iii, 178–180
- Unsoundness and warranty, iii, 423.

Bladders on skin, ii, 157.

Bladder-worms causing disease, i, 313, 315

Blade-bone—see Scapula.

Blanket stitch for wound-healing, ii, 416.

Blanket weed in water, iii, 127.

Blastodermic membrane in breeding, iii, 240, 250

Blawtong—a form of horse-sickness, ii, 55.

Blaze—appearance and origin, iii, 495, 499.

Bleeders—on skin, ii, 158, 159

Bleeding or Hemorrhage—
- Accidents and first aid, ii, 437–439
- Bloody urine and its causes, i, 347, 348.
- Drugs for, ii, 448, 454, 456, 462, 463, 464, 468; iii, 6, 7, 8, 14
- Due to—apoplexy, i, 412; brain and fracture, i, 497; ii, 234 dysentery, i, 290; face sinuses and fracture, ii, 239; liver and heart rupture, i, 309, 310, 479, nose, i, 501, 503, poisoning, iii, 53, skin bleeding, ii, 158, 159, warts, ii, 154, 155, weak blood-vessels, &c., i, 501, 502.
- Flooding in mares, ii, 57–62.
- Lungs and respiratory organs, i, 501–503; ii, 10
- Operation precautions, iii, 162, 166, 174, 183.
- Prevention of death by—structure of arteries and veins, &c., i, 443, 445.
- Wounds and their treatment, ii, 402, 408–419.
- [See also title Blood, Blood letting.]

Blepharitis ciliaris of eyelid, ii, 114.

Blepharophimosis of the eyelids, ii, 114.

Blindness—
- Causes—bone tumours, i, 417; cataract, ii, 121; eye-teeth, i, 332; iii, 389, 494; lead poisoning, iii, 52; optic nerve, &c., ii, 117, 122, 123
- Detection and tests, ii, 122, 123; ear movements, i, 43
- Moon-blindness, ii, 116–118; heredity of, ii, 121.
- Possibility of restoration of sight, ii, 121.
- Unsoundness and warranty, iii, 421

Blistering—directions and preparations, ii, 488, 490; iii, 5, 38–40, 107, after tenotomy, iii, 170; for hard mouth, i, 248; fractures and dislocations, ii, 230, 252, 348, 353, joints and sprains, ii, 284, 291, 293, 294, 296, 297, 298, 300, 355; trotters, iii, 310, vilhtis due to, ii, 383.

Blisters—glass-anthrax and dourine symptoms, ii, 44, 53; on hips and skin, i, 247; ii, 137.

Blood—
- Air changes in, due to respiration, i, 459–491.
- Bone nourishment, ii, 176, 177, 209
- Circulation—heart and blood-vessels' agency, i, 436, 441; mare and fœtus, iii, 253, 254; lungs, i, 487; prevention of death by hemorrhage, i, 443, 445; pulse and blood pressure, i, 443–445; testis supply, ii, 60; see also Arteries and Veins, Blood-vessels
- Composition, coagulation, &c., i, 439–436.
- Drugs, &c., acting upon, ii, 447; iii, 7; blood tonics, ii, 447, 449; cooling medicines, ii, 452–454; to reduce alkalinity and volume of blood, ii, 448–450, 471. See also titles Bleeding, Blood vessels.
- Nervous system—blood supply and regulation, i, 374, 380
- Parasites and other organisms—influence on, i, 313; ii, 41, 42, 52, 97, 166, 172, 174, 187.
- Pressure in circulation, i, 444, 445, 495.
- Quantity in horse, i, 431, 438, 445
- Respiratory process effect, i, 473, 487, 489–491.
- Skin influences, and diseases due to, ii, 130, 131, 138, 139.
- [See also titles Bleeding or Hemorrhage, Blood Diseases, Blood letting, Blood-poisoning, Blood-vessels.]

Blood-clot—healing wounds, ii, 405.

Blood diseases and disorders—
- Anæmia and plethora, i, 476–481.
- Causing—arthritis, ii, 285; dropsy, i, 311, 312; lymphangitis, ii, 22; skin affections, ii, 138, 139, 142; ulcers, ii, 427; tetanus effects, ii, 40.

Blood diseases and disorders—*(Cont.)*
Distribution—disordered, ii, 457, 458.
Exercise and the causes of disease, i, 216.
Hæmo-globinuria—analysis, &c., ii, 26–29; treatment, &c., ii, 29–31; fracture confusion, ii, 237.
Purpura hæmorrhagica, ii, 24, 25, 145; bleeding nose a feature, i, 503.
Pus due to brain abscess, i, 409.
[See also Blood-poisoning, Pyæmia.]
Blood-fibrine powders for sick horses, iii, 141.
Blood-letting—for apoplexy, i, 412; brain and staggers, i, 271, 407; enteritis, i, 294; exhausted horses, ii, 6; eye-vein, ii, 115; laminitis, ii, 337; plethoræ, i, 480, 481; pleurisy, ii, 15; quantity safe for, i, 433; thrombosis due to, i, 473, 474, 475.
Blood-poisoning—
Causes and effects—bone diseases, ii, 211; castration, iii, 174; covering disease, ii, 53, food, iii, 101; inversion of rectum, i, 302; joint disease, ii, 284; jugular vein abscesses, i, 477; kidney disease, i, 348; parturient fever, ii, 97; pleurisy and pneumonia, ii, 7, 14; skin eruptions, ii, 142, 143; strangles, ii, 41, udder inflammation, ii, 97, wounds and bacteria, ii, 406, 407, 414.
Forms of septicæmia or blood-poisoning, i, 481, 482.
Quinine uses, ii, 451.
Blood-spots on skin, ii, 24, 25, 156, 158, 159.
Blood-stained discharges—causes, &c., of foam at mouth, ii, 213; foot discharge, ii, 211; nose, i, 442, ii, 24, 238, poisoning, iii, 48; pneumonia, ii, 8; skin, ii, 25.
Blood tonics—action, &c., ii, 447, 447.
Blood-vessels—
Absorption of food—uses, i, 428.
As organs of circulation—structure, &c., i, 436, 441–443; chief vessels and their distribution, i, 447–453.
Causes or effect of broken vessels and rupture, i, 343, 347, 412, 420; cracked heels, ii, 424, fractures and sprains, ii, 228, 233, 255, 292; wounds, ii, 404, 408.
Drugs acting upon, ii, 454, 457, 462–464.
Nervous control of, i, 374.
Parasitic influences, i, 313; ii, 174.
Structure—in bladder, i, 357; bones, ii, 176, 177, 199, 200, brain and spine, i, 378, 380, eyes, ii, 105, 106, 108, hoof (model), ii, 421, intestines, i, 236; kidneys, i, 335, 336; liver, i, 239; lungs, i, 467, mare, embryo and fœtus, iii, 252, 254, 255, muscles, ii, 305, 306, skin, ii, 126.
Weakness causing hemorrhage, i, 501.
Bloody urine—causes and treatment, i, 342, 343, 344, 347, 348, 349, 350, 356; ii, 475; iii, 60.
Blowing—causes and disease symptoms, i, 450; ii, 5, 10.
Blows as cause of disease, i, 220.
Blue-green algæ in water, iii, 127, 128.
Blueness of membranes—causes, &c., ii, 470.
Blue pill—medicinal uses, ii, 438.
Bluestone—medicinal uses, iii, 2.
Bluetong—a form of horse-sickness, ii, 55.
Board of Agriculture—epizootic lymphangitis, ii, 64, 65.
Boats for horse-transit, iii, 463.
Body—conformation and defects, i, 90, 91, 103; ii, 120; head as unit of measurement, i, 91–101, height, weight, and other proportions, i, 91, 92, 93–96, 99; nutrition and constitution, iii, 87; water constituents, iii, 119, 120, 124.
Bog-spavin and its treatment, ii, 216, 290, 291; other influences, ii, 278, 299, 357, 358; unsoundness and warranty, iii, 384, 420, 421.
Boiled barley—preparation, iii, 28.
Boiled roots as invalid diet, iii, 27.
Boiler—stable fittings, iii, 322, 323, 332, 334, 337.
Boils on skin, ii, 150, 151.
Bolting of food—oats preparation, iii, 107.
Bolting vice—warranty, iii, 424.
Bolus for physic balls, ii, 444, iii, 18.
Bone-ash in the body, iii, 87.
Bones—
Arab merits, i, 202, 203.
Blood circulation means, ii, 176, 177.
Classification and number in a horse, ii, 177, 178.
Composition and growth of bone, ii, 175, 176, 178, 208; before birth, iii, 255, 292–294; after birth, iii, 294–298.
Diseases—food and water influences, iii, 103, 123, 124, joint disease origin, ii, 280, 281; metacarpal periostitis or sore shins, ii, 219, 220; necrosis and caries, ii, 212–214; osteo-porosis (big head) or soft bones, ii, 214–216; ostitis or inflammation, periostitis, ii, 208–212; ring-bone and splint, ii, 205–208; spavin, ii, 216–218.
Effects of epizootic lymphangitis, ii, 63; fistulous withers, ii, 433; rheumatism, ii, 21; tuberculosis, ii, 51.
Model of hoof and limb bones, ii, 401.
Muscles and tendons attachment, i, 333–335; ii, 300.
Odd- and even-toed animals, iii, 476, 477.
Phosphorus uses, ii, 490.
Protection of brain and spine from injury, i, 379, 380.
Structure—as levers, i, 333–335; of fore-leg, i, 19, 20; ii, 192–197; hind leg, i, 23; ii, 201–203; loins and back, i, 15, 22; ii, 203–205; pelvis, ii, 192; skeleton division, ii, 176, 178; skull bones—cranium, ii, 183–186; face, ii, 186–189; special features of horse structure, iii, 485–492; thorax or chest bones, ii, 189—sternum or breast bone, ii, 190, ribs and costal cartilages, ii, 190, 191; vertebral column and particular vertebræ, ii, 179–183.
[See also titles Dislocations, Fractures, Joints, Ossification, also names of bones, as Humerus, Os Hyoides, Jaw, &c.]
Bone-spavin—form and treatment, ii, 216–218, unsoundness and warranty, iii, 385, 420.
Bony growths—causing disease, i, 214, 417, 421, 473; firing, iii, 107; unsoundness, iii, 390, 393; water influences, iii, 124.
Boots—for canker, ii, 382; defective action and wounds, ii, 402, 414; poultice boot, iii, 70, training trotters, iii, 315.
Borax—medicinal uses, ii, 442; iii, 2; for stings, iii, 61.
"Border Lass"—fractured sesamoid bones, ii, 250.
Boric or boracic acid—antiseptic uses, ii, 421, 475; medicinal uses, iii, 2; doses, iii, 9.
Bot-fly—infesting stomach, ii, 169, 170; brain, ii, 175, tobacco destroying, ii, 421.
Bottles used in giving medicine, iii, 21.
Bourgelat's splint for fractures, ii, 247.
Bowed knees and legs—causes, muscles, &c., affected, i, 74, 80; ii, 303–305; sprain influence, ii, 285, 296.
Bowed tendon—defect and unsoundness, iii, 380.
Bowels—(see titles Intestines, Inflammation, Obstruction, Rupture).
Boxes—(see Loose Boxes).
"Bozra"—Arab mare (illust.), i, 294.
Brachial artery and veins—formation, i, 447, 449, operation, iii, 165.
Brachial plexus of nerves—formation, &c., i, 368–402.
Bracken for bedding, iii, 357.
Brackets for harness room, iii, 332.
Brain—
Blood supply, i, 380.
Connection with spine, ii, 184.
Diseases—abscess and tumours, i, 408, 409, 414, 415; age influence, i, 218; apoplexy, i, 412, cerebritis and meningitis, i, 405–407, collar pressure causing, i, 220, concussion, ii, 232; embolism, i, 473; fractured bones effect, ii, 234, 235, 236; indigestion and staggers effect, i, 268, 269, 271; jugular vein thrombosis effect, i, 475; nervous system causes, i, 405; paralysis, i, 420; pulse in, iii, 147; thickening of membranes, i, 417.
Drugs affecting, ii, 463, 464, iii, 2, 3.
Parasites, &c., infesting, ii, 162, 174, 175.
Protection from injury—bone formation, i, 379, 380.
Structure and functions, i, 9, 38, 39, 383–386; arteries, i, 451, 452, capillaries, i, 446; examination of fragment, i, 378, fœtus, iii, 257, gangha, i, 393, 400; nerves, i, 385, 390, 391–397, 444; weight, i, 383.
Vital spot stopping bleeding, i, 414.
[See also Cerebrum, Cerebellum, Cranium.]
Bran—as food, composition, &c., iii, 89, 99, 100, 350; disease due to, ii, 215; physic given in, ii, 445.
Bran disease—treatment, ii, 157, 152.
Bran mashes—preparation, &c., iii, 26, 109, 350.
Bran poultice—preparation, &c., iii, 29.
Brandy as a stimulant, i, 293, ii, 450.
Brass fittings in stables, iii, 324.
Bread poultices—uses, &c., iii, 28, 29.
Breakdown—due to fracture, ii, 231, to sprain of ligaments, &c., ii, 292, 534; firing ligaments, iii, 107, unsoundness and warranty, iii, 421.
Breaking-cart for training trotters, iii, 314.
Breaking-in—see Training.
Breast and breast-bone—sternum—conformation and defects, i, 86, 91, 92, 102; ii, 189, 190, muscles and connections, ii, 296, 324, 327, 334, 336; poulticing, iii, 322; ribs connection, ii, 191, 192, 267.
Breast collar for sore shoulders, ii, 426.
Breast presentation in parturition, iii, 281.
Breathing—see titles Respiration or Breathing, Respiratory Diseases.
Breech presentations in foaling, iii, 276–279.
Breeching-strap—undoing on fallen horses, ii, 443.
Breeding—
Aims and general requirements of, to-day, iii, 205–207, foundation stock, &c., iii, 211–213.
Back-breeding, or throwing back to ancestors, iii, 211, 212, 213, 231–245, 459, 467, 468, 513.
British early history, iii, 535–541; Tudor and subsequent periods, iii, 541–548.
Colour and skin markings—influences, iii, 493, 499.
Creation of the horse, and early history in, 515, 522, 524, 525, 527, 530.
Crossing—good influences of, iii, 549, 550.
Development and impregnation of ovum, growth of embryo, &c., in, 245–257, 261–264, 286–294, 295, 249.
Disqualifying ailments of sires, ii, 302.

Breeding—(*Cont.*)
Evolution and other influences, iii, 286, 287.
Food and water during pregnancy, iii, 208–210, 215–217, 265, 266; after birth, iii, 227, 228, 285; hand-rearing and weaning of foals, use of cow's milk, iii, 222–226.
Head formation indicating origin, i, 36, 37.
Height limitations, i, 94, 95.
King's premiums—conditions and objections, i, 149, 141.
Mating of mares and service of sires, iii, 213–215, 219, 234–238, 262, 297, 298; artificial insemination, iii, 233–234.
Organs of generation—see Reproduction.
Points transmitted from parents, iii, 248, 249, 257.
Rate of growth of horse, iii, 286–288; before birth, iii, 288–295; after birth, iii, 294–298.
(See also titles Foals, Mares, Stallions, Hereditary Diseases, History of the Horse, Laws, Parturition and Pregnancy, Reproduction, Sexual Intercourse, Sterility; for special breed see titles Arabs, Clydesdales, &c.]

Brewers' grains as food, iii, 89, 107.

Brewers' horses fatty livers of, i, 308.

Bricks for stables, iii, 60, 70, 325, 326.

Bridles—kinds and uses, iii, 358, 359; influence of conformation, i, 43, 45; poll evil due to, ii, 430, 432.

Bridoon bits—uses, i, 151, 152, iii, 313.

Brisket—structure, i, 16.

British horses—history, iii, 530, 535–550. See also titles Thoroughbreds, English, Suffolks, &c.

Brittle bones—fracture liability, ii, 223, 230.

Brittle hoofs—causes, iii, 304, 436; litter affecting, iii, 139; shelly feet, 368.

Broken bones, &c—see titles Fractures, Knees, Neck, Spine, for special bone see its name

Broken wind and its treatment, ii, 12–14; iii, 95; asthma distinction, ii, 11; cough due to, ii, 19, 472; dietary special, ii, 13; drugs, &c., ii, 454, 493, 472; iii, 15.

Bromides of potassium, sodium, and ammonium—medicinal uses, ii, 448, 477, iii, 2; doses, iii, 9.

Bromine, salts of—action on nervous system, ii, 477.

Bronchi form and uses, i, 486; diseases, &c—see Bronchial affections, Bronchitis.

Bronchial affections—bleeding lungs due to, ii, 19; broncho-pneumonia and drugs, ii, 1, iii, 3; catarrh test and drugs, ii, 39, 469; iii, 3; glands affected by tuberculosis, ii, 83; tubes disorders, ii, 1, 11. See also titles Asthma, Bronchitis.

Bronchial arteries—form, &c., i, 452.

Bronchial plexus and nerve connections, i, 506.

Bronchial tubes disorders, ii, 1, 11; muscles, ii, 306.

Bronchioles formation and uses, i, 486, 487.

Bronchitis and its treatment, ii, 1–4; climate effect, i, 222; complications, ii, 7, 10, 11; cough due to, ii, 18; iii, 140; drugs used, ii, 469, 472; iii, 2, 7; use of mustard, iii, 6.

Broom tops for liver inflammation, i, 308.

Brown water in yards—composition, &c., iii, 139.

Bruises drugs used, iii, 1; wounds due to, ii, 413, 423, iii, 315.

Bruit of heart due to disease, i, 460.

Brunner, glands of in digestion, i, 245.

Brushes for grooming, iii, 134, 135.

Brushing as defective action, ii, 396; examination for soundness, &c., iii, 374, 375, 380

Bubonocele—symptoms, &c., i, 318.

Buccal glands—formation, i, 230.

Buccal nerve—formation, &c., i, 393.

Buccinator muscle form, &c., ii, 308, 309

Buffed clot of blood, i, 436.

Bulb, The—of nervous system, description, i, 382

Bulb, The of penis, structure, &c., ii, 70.

Bullæ on skin, ii, 137, 140.

Bullous inflammation of skin, ii, 144

Bump of locality in horses—strength and failure, ii, 439, 440.

Burgundy pitch for fractured jaw, ii, 241.

Burnett's fluid—uses and nature of, i, 500; ii, 449, 488.

Burning the bars—cruelty, law, and results, i, 254.

Burns and scalds—drugs for, iii, 3, 5; eyelids affected by, ii, 112, 113.

Burnt alum and its uses, ii, 92, 456.

Burnt hay—effects of, iii, 119, 352, 353.

Burrowing mite causing skin disease, &c., ii, 140, 167.

"Bury Victor Chief"—breeding and price, &c., i, 185, iii, 214

Butter—antidote uses, iii, 15.

Butter of antimony poisoning by, iii, 51.

Buttock—conformation and length measurements from, i, 22, 86, 95, 96; eruption on, ii, 141.

Button-hole stitch for wounds, ii, 416.

Buying of horses guarantee of soundness, &c. see titles Examination, Warranty.

"Byerley Turk" history and descendants, i, 111; iii, 547.

C

Cabbage composition, iii, 89.

Cab-horses—feeding, iii, 9;

Cabs Roman origin and uses, iii, 523.

Cæcum of intestine, i, 237, worms in, ii, 172

Cæliac axis of aorta, i, 452.

Cake food disease due to, iii, 103

Calabar bean—medicinal uses, ii, 462, 483.

Calcaneo-cuboid ligament, ii, 278; enlargement causing curb, ii, 300.

Calcaneum or calcis—bone formation, i, 56, 87; ii, 103, 278, curb causes, ii, 300, fracture, ii, 231, 264, 262; muscle connections, ii, 344.

Calcareous degeneration of heart valves, i, 464, of tendon due to thoroughpin, ii, 358.

Calcareous deposits—in brain, causing vertigo, i, 408; tuberculosis appearances, ii, 51.

Calcic carbonate in urine, i, 353, 354.

Calcis bone—see Calcaneum.

Calculi (character and causes, i, 298, 299; distinction from tumour, i, 357, 363; fistula and colic due to, i, 201, 270; intestinal obstruction, i, 296, 298–300; kidneys, i, 370, 371, pressure causing, i, 226; penis and sheath, ii, 82, 83; salivary ducts, i, 203–205; urine indications, i, 344, 348, 351, 353; vesical calculus origin and composition, i, 354, 355, treatment, &c., i, 356–361, use of catheter, iii, 173; water influences, iii, 124. See also title Stone in the Bladder.)

Calf-knees—cause and recovery, i, 74, ii, 393.

Calkins—defective action due to, ii, 397, iii, 456; forms and uses, ii, 491; iii, 444.

Callosities—origin and forms, iii, 500–508; on asses and zebras, iii, 496.

Callous formations—fractured pastern, ii, 250; joint anchylosis, ii, 281; speedy cutting, ii, 401; ulcers, ii, 420, 427.

Calomel—medicinal uses, ii, 488; iii, 3; doses, iii, 10.

Calumba—medicinal uses, ii, 464, 466; dose, iii, 9

Camphor—medicinal uses, ii, 459, 469, 470, 471, 472, iii, 3; doses, iii, 9.

Camphorated oil—medicinal uses, ii, 460.

Canadian origin of Morgan horses, i, 207.

Canaliculi in bone structure, ii, 176, 177.

Canals in eye structure, ii, 108.

Cancellated tissue in bone, ii, 176, 177.

Cancer—as a disease of horse, ii, 156; fracture causing, ii, 224, penis glans, ii, 83.

Canine teeth—formation, i, 6, 230; ii, 189; iii, 390, 404.

Caninus muscle—form, &c., ii, 308, 309.

Canker of feet and its treatment, ii, 381–383, drugs, &c., for, ii, 450; iii, 7; horn appearance, ii, 133; unsoundness, iii, 382.

Canon and canon-bone (metacarpus)—conformation and defects, i, 20, 75–78, 87, 88, 102; ii, 147; iii, 477, diseases of bones, ii, 200, 210, 213; displacement, ii, 222; fetlock joint formation, ii, 272, 273; fractures, ii, 223, 224, 229, 230; growth before birth, iii, 293; muscles and insertions, i, 21; ii, 330, 331, 343, 344, 345; soundness examination, iii, 376, 377, sprain of check ligament, ii, 295.

Canter—action and forms, iii, 105–108; jumping from, iii, 199.

Cantharides—diseases due to use, &c., i, 348, 349, 350; ii, 475; medicinal uses and doses, iii, 3, 8, 9, 11, 263; poisoning by, iii, 60.

Canthus of eye—form, ii, 104

Capillaries—as organs of circulation, i, 446; of kidneys, i, 335, 336; of liver, i, 239, 240; of lungs, i, 487.

Capillary hemorrhage due to weakness, i, 501, drugs used, iii, 6, 7.

Capped elbow causes and treatment, i, 191; ii, 359, iii, 341; unsoundness and warranty, iii, 376, 420.

Capped hock and its treatment, ii, 362–364, iii, 343; unsoundness and warranty, iii, 372, 420.

Capped knee and treatment, ii, 360–362.

Capsicum—medicinal uses, ii, 462; doses, iii, 9, 11

Capsular cataract—formation, ii, 120

Capsular ligaments—joint formation, ii, 270, elbow, fetlock, coronet, and coffin joints, ii, 270, 272, 273, head and neck, ii, 268, 269, hip and hock, ii, 274, 278; interspinous connections, ii, 265; jaw and temporal bone, ii, 266; knee, ii, 272; ribs and sternum, ii, 267; rheumatic effects, ii, 286; shoulder joint, ii, 270.

Capsules—of kidneys, i, 334, 335; rupture of liver, i, 300, 310

Caput magnum, parvum, and medium of triceps muscle, ii, 330.

Caraway seeds—dose, iii, 9

Carbohydrates—classed as foods, i, 242; constituents, &c., in food, iii, 88, 89, 91, 96, 97, 98, 100.

Carbolic acid—antiseptic and medicinal uses, ii, 420, 484, 487; iii, 3, 9, 155; for dung, i, 292; inhalation of, ii, 471; poisoning effects, ii, 129, 130; iii, 47, 48.

Carboluria—causes, &c., of, ii, 420.
Carbon dioxide—in air, iii, 78; lung discharge and action of blood, i, 431, 448, 494; respiratory uses, &c., i, 482, 483, 489, 490, 491; ventilation effects, i, 495.
Carbonate (medicinal uses of ammonium and ammonia, ii, 459; iii, 3. of iron, ii, 447, 456; of lime, ii, 450, 457; potash, ii, 448; soda, ii, 449; iii, 61; zinc, ii, 456; doses, iii, 9.
Carbonate of lime in stone of bladder, i, 355.
Carbonic acid—see Carbon Dioxide).
Carbuncles—antiseptics for, ii, 421.
Carcasses of animals died of anthrax—destruction, ii, 43.
Cardamoms—uses and dose, ii, 467; iii, 11.
Cardboard for fracture support, ii, 261
Cardiac region of stomach, i, 234; heart disease detection, i, 458, 462, paralysis due to digitalis, ii, 401.
Carditis—a form of heart disease, i, 454
Caries of bone—causes, &c., ii, 212–214, 390; tuberculosis classed as, ii, 51.
Cariniform cartilage of breast-bone, ii, 190.
Carminatives—medicinal uses, ii, 466; iii, 13.
Carotid arteries of neck, i, 13, 376, 451; muscle separating jugular vein, ii, 321; pulse near, iii, 140.
Carotid plexuses—formation, i, 376.
Carpal articulation—form, &c., ii, 271.
Carpo-metacarpal articulation—form, &c., ii, 271.
Carpus—formation, &c., ii, 196, 271, 272; iii, 486. (See also Knee.)
Carriage horses—breeding for, iii, 206; breeds used, i, 125, 126, 128, 132, 208, 209, 210; feeding, iii, 93; physic, ii, 445. (See also Harness Horses
Carriage of a horse—head influences, i, 43, 46; neck affecting, i, 48–51. show and harness horses, iii, 312, 313. (See also titles Action, Defective Action.)
Carriage of horses—(see Transit).
Carriages—introduction and uses, iii, 521, 528, 542, 543.
Carriage-washing stand—structure, iii, 335.
Carron oil and its uses, iii, 3, 5.
Carrots as food, ii, 89, 91, 99, 115, 351; special diet, iii, 26, 27, 311, 463.
Cart horses—(see Draught Horses).
Cartilages—bone growth, ii, 178; chest, i, 63, 64; ear, i, 10; ii, 310, 311; foot, iii, 436; fore-limb, ii, 193, 194, 198; hind-limb, ii, 202; joint structure and diseases, ii, 262, 280, 281, 286; loose cartilages causing disease, ii, 284, 285; larynx, i, 485; nose, i, 9; quittor treatment, ii, 380, ribs and sternum, ii, 190, 191; side bones due to ossification, ii, 387; stifle-joint, ii, 276; trachea, i, 485; vomer bone, ii, 188.
Cartilaginous quittor—form, &c., ii, 379
Carunculæ myrtiformes of hymen, ii, 75.
Cascarilla bark—uses, ii, 466.
Caseous degeneration a form of tuberculosis, ii, 50.
Casting—for operations, methods and hobbles, iii, 159, 160, 162, 168, 169, 172, 173, 182; fractures, ii, 225, 229, 256, 261, 262; injuries and first aid, ii, 424, 437
Castor-oil—uses and dose, ii, 444; iii, 9.
Castors on fore-limb, i, 19.
Castration operation—
Advantages, necessity, and age, iii, 171, 172
Castration operation—(*Cont.*)
Casting and preliminary preparations, iii, 172, 173, 176.
Diseases following, and reduction of liability to disease, ii, 60, 80, 81.
Hernia treatment, i, 318, 319, 320, 323.
Methods and instruments—by actual cautery, iii, 166, 172–174, by caustic clamps—covered and uncovered operations, i, 321, 323; iii, 175, 176; by standing operation, iii, 176, 177; by torsion and ligature, iii, 174, 175.
Rigs or cryptorchids, iii, 184–186; results of operations, table, &c., iii, 186–188.
Casts in urine, i, 345.
Catalepsy and its treatment, i, 410.
Cataplasms—use, &c., ii, 474. iii, 30.
Cataract—forms, causes, and detection, ii, 108, 119–122, 123; iii, 370; hereditary, iii, 215; spot mistaken for, ii, 110; unsoundness and warranty, ii, 302; iii, 366, 370, 421.
Catarrhal affections—climate effect, i, 222; common form of cold, i, 497; drugs, &c., used, ii, 448, 454, 468, 485; iii, 3, 8; influenza distinction, ii, 31, 32; nasal catarrh, i, 499–501; pneumonia complication, ii, 8; skin inflammation, ii, 146–148; strangles a form of catarrh, ii, 30, 40.
Catechu—medicinal uses, ii, 455; iii, 3; doses, iii, 9.
Catgut for navel-string, ii, 288; for wound stitching, ii, 411, 415, 416.
Catheter—operation of passing, ii, 71, 72; iii, 177–180; use in various diseases, i, 352, 357. ii, 29, 30, 259.
Cattle—foods and digestion, iii, 88, 89, 96, 97; glanders and lymphangitis, ii, 37, 60, 61; poisoning causes, iii, 48, 104, 105, 106; silage for, iii, 116, 117. water for, iii, 120, 130.
Cattle plague—cause, &c., i, 223.
Caudal branches of nerves from spine, i, 381.
Cauliflower growths in valvular disease, i, 464.
Causes of disease—classification, &c., i, 214; the action of bacteria, i, 226–229. See also titles Exciting, Predisposing, Specific, &c.
Caustic alkalies—poisoning and antidotes, iii, 45, 48, 52.
Caustic clamps for castration, iii, 175, 176. in standing, iii, 176
Caustics—acids, &c., used, i, 453, 468, 484; iii, 13. for quittor and canker, ii, 380, 382; for warts, ii, 155; lip troubles due to, i, 248.
Cautery—application and uses, iii, 166, 167; for castration, iii, 172–174; fistulous withers, ii, 434. hemorrhage, i, 503; quittor, ii, 380; penis amputation, ii, 85; poll evil, ii, 431; ringbone, ii, 206; sand crack, ii, 367; ulcers, ii, 427
Cavalry—ancient history and uses, iii, 520, 521, 523, 524, 525, 530, 532; British early history, iii, 535, 536, 537, 542, 545
Caveat emptor—sale of horses and warranty, iii, 407, 410, 412, 426
Cavernous plexuses—formation, i, 376.
Cavesson for hunters, iii, 307.
Cavity of the belly—muscles and form of, ii, 338, 341.
Ceilings—stable structure, iii, 320, 323.
Cells—bacteria description, i, 226; in impregnation, &c., iii, 248, 249, 250, 257; structure of bladder, i, 337. kidneys, i, 335, liver and fatty liver, i, 239, 308, 309, saliva, i, 232; skin, ii, 124, 125. (Nerve cells, see that title
Cellulitis—causes, ii, 362, 387, 397.
Cellulose in food, iii, 96, 97, 98, 100.
Cement for stable walls and floors, iii, 70, 325, 326, 327, 334.
Cementum of teeth, iii, 494
Centaurs—origin of half-horse half-man, iii, 521
Centenarius—horse termed, iii, 527.
Central canal of spinal cord, i, 382.
Centre of gravity in a horse, i, 28–30. iii, 102–104.
Cephalic artery—formation, i, 449, 450.
Cercaria and alternate generation, &c., iii, 260, 480
Cereals—food properties and analysis, i, 241, 243. iii, 345
Cerebellum disease causing giddiness, &c., i, 405; protection from injury, i, 379, 380. structure and nerves, i, 383–386. (See also Brain.
Cerebral arteries forming internal carotid, i, 451.
Cerebral disorders—see title Brain Diseases
Cerebral nerves—origin and names, i, 385.
Cerebritis and its treatment, i, 405–407
Cerebro-spinal meningitis—form, &c., i, 423–425.
Cerebro-spinal system and nerves—(see title Nervous System.
Cerebrum formation and nerves, i, 383–386; protection from injury, i, 379, 380 See also Brain.
Certificates of soundness—see Warranty).
Cervical crest and groove of neck, i, 12, 13.
Cervical nerves—structure, &c., i, 375, 376, 381, 397.
Cervical panniculus muscle—form, &c., ii, 320.
Cervical trapezius muscle—form, &c., ii, 320, 322
Cervical vertebræ—formation, ii, 170, 181; fracture, ii, 235; ligament and muscle connections, ii, 265, 318–320, 321, 322; poll evil affecting, ii, 430.
Cervico-auricularis muscles—forms of, ii, 312.
Cess-pools in stable drainage, iii, 320, 329.
Cestodes causing liver diseases, i, 313.
Chaff as food—amount and mixtures, iii, 93, 107, 112, 344–346, 353
Chain for tying of horses in stalls, iii, 328.
Chain snaffle—type of, iii, 358, 359.
Chalk medicinal uses, ii, 457; iii, 3; in water, iii, 122, 131.
Chamois leather as a plaster, iii, 43.
Chamomile medicinal uses, ii, 466, 474.
Channel of the neck, i, 13.
Channels in stable drainage, iii, 328.
Chapman's horse—name for pack-horse, i, 127.
Chapped heels—applications for, ii, 457; iii, 4.
Chapped skin—causes, ii, 127.
Character in breeding, iii, 212, 213.
Charcoal as an antidote, iii, 58.
Chargers—origin of horses, iii, 530, 541, 543.
Charges—application and uses, iii, 42, 43.
Chariot-racing inauguration and history of, iii, 521, 522, 524, 527, 537.
Chariots for war, &c.—use of horses, iii, 517, 519, 520, 521, 523, 524, 525, 527, 528, 531, 535, 536, 537, 550
Charlier system of shoeing for speedy cutters, ii, 401, 402
"Cheadle Jumbo"—measurements, i, 65, 66.
Check ligament of canon, i, 75; muscles insertion, ii, 331, 332; sprain, &c., ii, 294, 346; soundness examination, iii, 380.
Cheek and cheek-bone—formation, i, 11, 12. ii, 185; fistula, ii, 429; muscles, ii, 308.

Chemical causes of disease, i, 220.
Chemical changes due to bacteria, i, 227.
Chemical composition and stimuli of nerves, i, 387, 388.
Chest or thorax—
Bones and conformation, i, 3, 16, 62–64; ii, 189–191; compensating points, i, 102; height and width tables, &c., i, 64–66; narrow chest effects, ii, 400, 422, iii, 119.
Disorders—fluid due to pleurisy, ii, 14, 16, 17; hemorrhage, i, 502; ii, 10; punctured or perforated chest, ii, 10, 255; tuberculosis, ii, 51; worms, ii, 174. See also names of diseases, as Asthma, Bronchitis, &c.
Examination for heart disease, &c., i, 460, 466.
Muscles connected with, ii, 323, 327, 335.
Poulticing, &c., iii, 32, 33.
Respiratory functions, &c., i, 491–494; breathing capacity affected by conformation, i, 30, 61.
Chest-founder—a form of navicular disease, ii, 389.
Chestnut colouring—of Arabs, i, 205; of Suffolk horses, i, 195, 196, 199.
Chestnut hunter "Artist" illust., ii, 450.
Chestnuts on limbs—formation and origin, i, 19; ii, 133; iii, 500–508; as digit remains, iii, 478.
Chewing of food—observations on, i, 233, 246, 247.
Chiasma of optic nerve, i, 392.
Chilled water for sick horses, iii, 142.
Chills—drugs used, iii, 3 (see also Cold).
Chin—conformation, i, 12; fall and first-aid directions, ii, 438.
Chin groove—position, i, 12.
Chinese history on the horse, iii, 517, 518.
Chinosol for wounds, ii, 421.
Chloral hydrate—medicinal uses, ii, 476, 477, iii, 3, 9; poisoning and antidote, iii, 45, 46, 58.
Chlorate of potash and potassium—medicinal uses, ii, 448, 449, iii, 3; doses, iii, 9.
Chloric ether—medicinal uses, iii, 3; doses, iii, 10.
Chloride (medicinal uses) of ammonium, ii, 459, iii, 3; of mercury, iii, 3, 10; soda and sodium, ii, 449, iii, 9; zinc, ii, 450; iii, 4.
Chlorinated lime—as a disinfectant, ii, 486; medicinal dose, iii, 9.
Chlorine gas for disinfection, ii, 487; iii, 155.
Chloroform—fracture treatment, ii, 225, 230; hernia, i, 320, 321, 323; medicinal uses, iii, 476, 479, iii, 9; operations, iii, 166, 167, 181, 182, 184; poisoning and antidote, iii, 45, 46, 58; restorative use of ammonia, ii, 459.
Chlorophyll-green algæ in water, iii, 127, 128.
Choking and its treatment, i, 265–267; asphyxia causes, i, 494; formation of larynx, &c., preventing choking, i, 480.
Cholera—water causing, iii, 130.
Cholesterin in blood, i, 432, 435.
Chologogues and their uses, iii, 13.
Chorda dorsalis—form, iii, 250, 255.
Chorda tympani nerve of face, i, 233, 394.
Chorea and its treatment, i, 410, 411; drug, iii, 3.
Chorion of ovum—formation, iii, 251.
Chorium of skin, ii, 124, 126.
Choroid plexus of brain, i, 384, œdema or tumours of, i, 414, 415, 416.
Choroid tunic of eye, ii, 105, 106, 107; disease of veins, ii, 124.
Chromic acid—medicinal uses, iii, 7.
Chronic diseases—definition, i, 213; temperaments liable to, i, 218.
Chyle in absorbent system, i, 427, 428, 429, 430.
Chyme in intestinal digestion, i, 245, 246.
Cilia processes of trachea, i, 485.
Ciliary processes of eye, ii, 105, 106.
Cinchona—medicinal uses, ii, 451, 452, 467, iii, 4; doses, iii, 9, 11.
Cinchonine—medicinal uses, ii, 452.
Circle of Willis—formation of arteries, i, 451.
Circulation system and organs—
Disease and disorder—general causes, i, 215, 216, 218, 221, ii, 457, 458; iii, 136, 146, obstruction causes, i, 465, 466, 474, 477; poisoning effects, iii, 44, 45; sick horses stimulation, iii, 143; uterus inversion, ii, 101.
Embryo and fœtus growth, iii, 255–257.
Mechanism of the circulation, i, 430; diagram of, i, 450.
Prevention of death by hemorrhage, i, 445.
Pulse and blood-pressure, i, 443–445; ii, 146, 147.
[See also titles Arteries and veins, Blood, Blood diseases, Blood-vessels, Heart.]
Circumferential fitting in shoeing, iii, 447.
Circumflex nerve—formation, i, 401.
Circus horses—diseases due to training, iii, 202; Roman uses, iii, 526, 527, 528, 530, 531.
Cirrhosis of liver, i, 307; fatty liver influence, i, 368.
Citrate of iron and ammonium—medicinal use, ii, 447, dose, iii, 9.
Citric acid—dose, iii, 9.
Clacking of shoes—(see Forging).
Clamps and clamping—for castration, iii, 173–177; hernia, i, 317, 321, 322, 325; for sand crack, ii, 367.
Claws—formation, ii, 131, 133; classification of animals by, iii, 475.
Clean-cut wounds—form and treatment, ii, 402, 410.
Cleaning horses—(see titles Grooming, Washing).
Cleanliness in the stable, iii, 323, 327.
Cleansing of wounds—methods, ii, 490, 415.
Cleft of frog—discharge from, and wounds to, ii, 373, 385.
Cleveland Bay "Speciality" (1562)—illust. of, i, 258.
Cleveland Bays—
Conformation, stamina, and action, i, 131–133.
Crosses—hackney, i, 130, 131; Scottish early breeding, i, 188; thoroughbreds, i, 127, 128, Yorkshire coach horses, i, 133.
Harness horse qualifications, i, 152, 153.
Oldenburghs compared with, i, 208.
Origin, uses, and districts breeding, i, 125–128.
Stud-book introduction, &c., i, 129, 130.
Clever jumpers—methods, iii, 200.
Climate—as cause of disease, i, 213, 222, 292; breeding and size influences, iii, 530, 531, 532, 535, 546, 548.
Clinches used in shoeing, iii, 450.
Clinker bricks for stable floors, iii, 326.
Clipping and clippers for grooming, iii, 137, 138, 360.
Clips for shoes, iii, 449; injuries from, iii, 453.
Clitoris of vulva, i, 18, ii, 74, 75.
Close-coupled head—form, i, 44, 45.
Closets—for stablemen, iii, 335.
Clothing—advisability of, iii, 138; infection and disinfection means, ii, 159, 151, iii, 24, 152; sick horses, iii, 24, 143; slip-board horses, iii, 462, tearing by horses, iii, 341; training horses, iii, 303.
Cloths—for wound-dressing, disinfection of, ii, 415.
Clots of blood causing apoplexy, i, 412; arteries obstruction, i, 473, œdema of choroid plexus, i, 416; uterine hemorrhage, ii, 87, 88.
Clotting of blood—see Coagulation of the blood.
Cloudy cataract—form, iii, 370.
Clover—as food, iii, 80, 91, 110, 111–351, 352, for invalid diet, iii, 26; colic caused by, i, 283, 284.
Clydesdale horses—
Conformation, leading characters and action, &c., i, 191–193; shoulder form, i, 72.
Early breeding, origin, and distinction, i, 180–191, 193.
Galloway, Ayrshire, and other strains of, i, 190, 193.
Illustrations of stallions, i, 280; ii, 321.
Shire resemblance and crosses, i, 186, 190, 191.
Suffolks compared with, i, 194, 196.
Title of "Lanarkshire" applied to, i, 189.
Clysters—administration and uses, i, 281; iii, 34.
Coach horses—Cleveland Bays, i, 126, 128, harness and hunter breeding, i, 136, 152, 153; Percherons, i, 205; state coach horses, i, 177, 206; Suffolks, i, 195; Yorkshire breed, i, 133–135.
Coach-house—structure, iii, 334; plans, iii, 320–324.
Coaches—origin of, iii, 543.
Coagulation of the blood, i, 435, 436; prevention of hemorrhage by, i, 445; thrombosis due to, i, 473, 474.
Coalesce in wound-healing, ii, 405.
Coal-tar—antiseptic uses, ii, 421.
Coaptation of wounds—means, &c., ii, 410, 411, 412, 438, stitches, ii, 418, 419.
Coarse conformation—of head, i, 37; of withers, i, 52, 54; unsoundness, iii, 384, 385.
Coats—blistering, iii, 38, 39; drugs affecting, ii, 453, 474, 491, mustard plasters on, iii, 33, temperature affecting, iii, 302, trotters training, iii, 316; washing in disease, iii, 35. See also titles Clipping, Grooming, Singeing, Hair, Staring coat.
Coats—of arteries, i, 442; of eye, ii, 104, 105.
Cobs—height, and distinction from ponies, i, 94, 153, 158.
Cocaine—medicinal uses, ii, 475, 479, 483; iii, 4, for operations, iii, 160, 166.
Cocci of bacteria—cell formation, i, 226.
Coccidia forms of parasites, ii, 101, 169.
Coccygeal arteries and nerves—formation, i, 378, 402.
Coccygeal bones or vertebræ—forms, ii, 179, 183.
Coccyx—(see Tail).
Cod liver oil—medicinal uses, iii, 4; doses, iii, 9.
Codeia—medicinal uses, ii, 480.
Cod-wax in sheath—removal, &c., ii, 84.
Coffin bone—(see Pedal bone).
Cognizable forms of disease, i, 219.
Coins as medicine weights, iii, 12.
Colchicum—medicinal doses, iii, 9, 11; poisoning by, iii, 62, 104.
Cold—common ailment, i, 497, due to clipping, &c., iii, 136, 138; unsoundness

Cold (*Cont.*)—
and warranty, iii, 421. (See also Catarrhal affections
Cold applications—astringent properties, ii, 484; douche for sick horses, iii, 35; for various diseases, i, 412, ii, 208, 220, 431, 434; poultices cold, iii, 28.
Cold, climatic—causes of disease, i, 217, 219, 222, 447; cracked heels due to, ii, 424; eyes affected by, ii, 111, 114, 121; horses endurance, i, 156; urinary effects, i, 338.
Cold fitting in shoeing, iii, 440.
Cold v. warmth in stables—ventilation, &c., iii, 76, 80, 81
Cold-water injections for uterine hemorrhage, ii, 89
Cold-water irrigation—for bone diseases, ii, 208, 218, 392, capped hock, ii, 363; cmb, ii, 302; fracture, ii, 238; joint synovitis, ii, 283, laminitis, ii, 378, sore shins, ii, 220; sprains, ii, 291, 296, 297, 300, 354; wind-galls, ii, 357, wounds, ii, 408
Coldness of body due to poisoning or disease, iii, 47, 54, 142, 143
Colic—
Causes, forms, and treatment spasmodic colic, i, 278–281; flatulent, i, 281–284, wheat and wind-sucking causing, iii, 109, 140
Distinction from enteritis, rupture, or heart pains, i, 293, 295, 469
Drugs and remedies for, ii, 459, 460, 462, 477, 481, 485; iii, 3, 6, 7, 8; prescriptions for draughts, iii, 18; unloading rectum, iii, 34.
Symptoms or results of other diseases—anthrax, ii, 42; arteritis, i, 471; cribbing and wind-sucking, i, 414, enteritis, i, 292; intestinal obstruction, i, 297; inversion of rectum, i, 301, liver and kidneys, i, 307, 349; parturient fever, ii, 68; poisoning, iii, 47; rupture, i, 295; spasm of diaphragm, i, 313; worms, ii, 171.
Unsoundness and warranty, iii, 423.
Collapse and syncope (fainting—causes, ii, 222; ii, 158, 440; remedies, ii, 458, 477.
Collar-bone—absence in horse and ungulate mammals, iii, 476, 487
Collar-holder for harness room, iii, 332.
Collar pressure, &c., causing disease, i, 220; boils, ii, 150, 151; erythema, ii, 145; fistulous withers, ii, 432; giddiness, i, 407, 409, sore shoulders, &c., ii, 145, 435, 436; tumours and ulcers, i, 415; ii, 426.
Collateral ganglia of sympathetic nerves, i, 374.
Collisions first-aid directions, ii, 437–439. fractures due to, ii, 254, 261
Collodion—castration uses, iii, 186.
Colon of intestine, i, 236, 237, 238
Colour of a horse—ancestral and nervous influences, iii, 497, 498; digestion and water influences, iii, 119, 130; distinction of horse family, iii, 495–497; washing light-coloured horses, iii, 137.
Colts—dropsy, i, 311; enclosure of penis, &c., ii, 81, 82, intestinal obstruction, i, 296; hip and wart troubles, i, 248; teeth shedding, &c., i, 326. See also Castration.)
"Coming Four"—age indications, use of term, iii, 393.
Commensalism—a form of parasitism, ii, 160.
Comminuted fracture—form and treatment, ii, 221, 225, 226, 228, 233, 249.
Commissure of optic nerves, i, 392.
Commissures—grey and white, of brain, i, 383.
Common adder causing poisoned wounds, ii 415.
Compact tissue in bone, ii, 176.
Companionship requirements of horses, iii, 94.
Compensating points in conformation—length and conformation, i, 97, 98, list of points and defects, i, 101–103
Compensation for glanders and farcy, ii, 37.
Complemental air in breathing, i, 443.
Complete dislocation—form, ii, 346
Complete fracture form, ii, 221, 225.
Complexus muscle form, &c., ii, 318
Compound fracture form, &c., ii, 221, 227, 228, 233–234
Compresses—for bog-spavin, ii, 291, thoroughpin, ii, 350, vilhtis, ii, 324
Compressor coccygis muscle—form, &c., ii, 326.
Compressor urethræ muscle—form, ii, 71
Compulsory keeping of horses—ancient law, iii, 542.
Concave shoe form, &c., iii, 443.
Concentrated food danger as diet, iii, 344
Conception see Impregnation).
Conchal cartilage of ear, ii, 310, 311.
Concrete—for stable floors, &c., iii, 326, 334, manure pit, iii, 335
Concretions formation of internal, i, 300; difference of calculi or stones, i, 299; disorders due to, i, 270, 296; pus in guttural pouches, i, 504–507; water influence, iii, 124.
Concussion brain, due to fractured bones, ii, 234, 238, knee protection, ii, 197; sore shins due to, ii, 219; spinal cord, resulting in paralysis, ii, 236, 237.
"Condition"—uses of terms "bad condition", "dealer's condition", &c., i, 457; ii, 445, 446.
Conditioning—balls and powders, &c., ii, 445, 446, 452; iii, i, 4, 16, breeding affected by, iii, 215, 237; causes and signs of disease, i, 221, 272, 275, ii, 260; iii, 145; fit condition recognition, iii, 330, 340; foals' diet, iii, 224, 225; feeding improvement, iii, 92, 93, 141; show horses, iii, 319, 313; skin improvement, ii, 473; training of thoroughbreds, &c., iii, 301, 305, 306.
Condyles of various bones, ii, 181, 184, 186, 198, 199, 201; fracture effects, ii, 244, 260.
Condy's fluid—antiseptic uses, ii, 486.
"Confidence" (1887—pedigree, i, 122.
"Confidence" (D'Oyley's 153, hackney stallion illust.), i, 172.
Conformation and defects—
Acquiring knowledge of—value, i, 27.
As predisposing cause of disease, i, 214
Bones as levers, i, 33–36.
Breeding precautions for weak points, &c., iii, 213.
Centre of gravity, and equilibrium, i, 28–31; iii, 192–194
Compensating points for defects, lists, &c., i, 101–103
Defective action due to, ii, 398, 399, 400
Distribution of weight of body, i, 91–93.
Height, length, and width, i, 94–98, proportions of height to length, and head as unit of measurement, i, 99–101.
Muscles in relation to power and speed, i, 31–33.
Soundness and warranty, iii, 375, 411–413, 420–423
Special features and origin of a horse, iii, 484–497.
[For special part or organ see its name; special breeds, see their titles.]
Congenital diseases and formation—canon, i, 77; cystic ovary, ii, 103; eye growths, ii, 118; flooding, ii, 88; foot inequalities, i, 81; hernia or rupture, i, 315, 316, 318, 322, 323;
Congenital diseases (*Cont.*)—
knees, bowed, i, 74, ii, 393; skin affections, ii, 153, 156, 157 See also titles Deformities, Hereditary
Congenital dislocation—form, &c., ii, 346, 347.
Congestion excitement and exertion causing, i, 215, 222, of liver, i, 293; iii, 43; of lungs, ii, 5, 7 air in lungs, iii, 142—remedies for lungs, ii, 460, 479, heart affected by lungs, i, 457, of palate, i, 254.
Conglomerate calculus—appearance, &c., i, 340
Conical teeth formation, iii, 494
Conium—medicinal uses, ii, 472, 483
Coni vasculosi of testicle, ii, 67
Conjugatæ in water, iii, 128
Conjunctiva of eye, ii, 105, diseases, ii, 114, 116–118, eyelashes in contact, ii, 112, 113, plethora and horse-sickness effects, i, 470; ii, 56
Conjunctivitis and its treatment, ii, 114.
Connective tissue in eye, ii, 105, muscle, ii, 68, trunk and spine, ii, 265; wound-healing, ii, 404, 406
Connemara ponies—form, &c., i, 168.
Consciousness—drugs, &c., affecting, ii, 458, 472, first aid for restoring, ii, 440, reflex movements, i, 380, symptoms of brain disorder, i, 406, 424, of fractured skull, ii, 234
Constipation and its treatment, i, 284–286, aperients and drugs for, ii, 442, 465, 478, iii, i, difference of obstruction, i, 296, foods, iii, 220, 224, inversion of rectum due to, i, 301; symptoms of diseases, i, 272, 293, 294, 300, ii, 109, iii, 139
Constitution and training considerations, iii, 301, 304, 305
Constitutional diseases see titles Hæmoglobinuria, Lymphangitis or weed, Purpura hæmorrhagica, Rheumatism.
Constrictor muscles—form, ii, 366.
Constrictor nerves—influence on food, i, 444.
Consumption (see Tuberculosis)
Contagious diseases classification, definition, and causes, i, 210, 223, iii, 152, drugs and disinfectants, iii, 3, 13, 23, 24, duration or covering disease, ii, 52, 80, 82, epizootic lymphangitis, ii, 59–65, 428, horse-pox, ii, 43, 44, isolation, iii, 154, mange, ii, 168; microbes producing, i, 222, pneumonia, ii, 7, 12, ringworm, ii, 149; skin affections, boils, &c., ii, 150, 151, sore throat, i, 254, South African sickness, ii, 53–59, stomatitis pustulosa, ii, 49, 50, tuberculosis, ii, 50–52. (See also titles Anthrax, Fevers, Glanders and farcy, Infections diseases, Influenza, Rabies, Strangles, Tetanus
Continental horses see title Foreign horses, also names of countries or breeds.
Contractile substance of muscle, ii, 365.
Contraction of arteries in circulation, i, 413
Contraction of foot causes, treatment, &c., ii, 379, 393, 395, unsoundness and warranty, iii, 378, 382, 420
Contraction of muscle or tendon causing deformity, ii, 346, 347, 348, 491, fracture, ii, 222, 224, 236, spasm, ii, 289, carriage of head affected by, i, 46, 50; contractility of muscle as regards power and speed, i, 32, foals at birth, iii, 221; operation for, iii, 168–171; substance of muscle causing, ii, 305
Control of horses during operations, means of restraint, iii, 156–160.
Contused wounds and their treatment, ii, 403, 412, 413; speedy cutting effects, ii, 401.

Conveyance of horses—see Transit.
Convolutions of brain substance, i, 384.
Convulsions—causes, i, 406, 410, 470; drugs, ii, 463; iii, 2, 3; heart and hemorrhage symptoms, i, 467, 502; ii, 88; sheep-dip effects, ii, 120.
Cooked food as diet, iii, 340.
Cooling drinks—preparation, iii, 28.
Cooling medicines acting on blood, ii, 450–452.
Co-ordinating nerve centres—forms, i, 389.
Copaiba—medicinal uses and dose, ii, 470, 471, 474, iii, 9
Copper—medicinal uses, ii, 454, 456; poisoning by, iii, 46.
Copulation—diseases due to, ii, 52, 53, 80; hernia causes, i, 110; penis as organ of, ii, 69; seminal fluid conveyance, ii, 71, 72, 73; sterility and pregnancy, iii, 230.
Coraco-humeralis muscle—form, &c., ii, 320.
Coracoid process—of scapula, and muscles, ii, 193, 329.
Cord—for castration, iii, 175
Cordials—prescriptions for medicine, iii, 15, 17, 18.
Corn—as food, iii, 91, 118, 347; with hay as sole diet, iii, 344–346, 347. See also titles Grain, Oats.)
Cornea of eye, i, 11; ii, 104, 105; amber tinge cause, ii, 116, 117; diseases, ii, 115–117; examination for disease and soundness, ii, 110; iii, 368; growths from, ii, 118.
Corner teeth—form and wear, iii, 398, 399, 400, 401; space near, iii, 404.
Corns—causes and treatment, ii, 374–376; iii, 435, 453, 454; canker due to, ii, 381; flat feet effects, i, 82; remains of digits, iii, 478; "unnerving" precaution, iii, 161; unsoundness and warranty, iii, 421.
Cornu of spine—formation, i, 382.
Cornua of tongue bone, ii, 189; muscles, ii, 313
Coronal process of coffin-bone, ii, 200.
Coronary arteries of heart, i, 448
Coronary cushion of coronet—form and disease, ii, 383
Coronet—conformation and bones, i, 21, 22, ii, 199, 273; iii, 436; corn and abscess, ii, 375, 376; fistulous coronet or quitter, ii, 378, 379, 381, 435; foot striking due to defective action, ii, 396, 398; herpes disease, ii, 149; pricks and wounds, ii, 387; sand crack, ii, 366; seedy toe, ii, 370, 371; shelly feet, ii, 368; side-bones above, ii, 387; soundness examination, iii, 381; vilhtis affecting, ii, 383–385.
Coronoid process of jaw-bone, ii, 189; fracture, ii, 240.
Corpora cavernosa of penis, ii, 70.
Corpora nigra of eye, ii, 106, 107; iii, 369; examination, ii, 110
Corpora quadrigemina of the pons, i, 388.
Corpora striata of brain, i, 383, 390.
Corpus luteum of ovum, ii, 80.
Corpus spongiosum of penis, ii, 70.
Corpuscles of blood—composition, &c., i, 431–434; diapedesis process, i, 434, 446; drugs affecting, ii, 447, 448, 449, 459; symptoms of diseases, i, 478; ii, 24.
Corrosive poisons—list and treatment of poisoning by, iii, 46–54
Corrosive sublimate—antiseptic and other uses, ii, 420, 486, 488, iii, 4
Costal cartilages of ribs, i, 63, 64; ii, 191, 192.
Costo-sternal ligaments—form, &c., ii, 207.
Costo-vertebral, and costo-sternal articulations of ribs, ii, 207
"Cottager"—steeple chasing records, i, 124.
Cotton cake as food, iii, 89, 94, 114, 115.
Cotyloid cavity of coxa, ii, 274
Cotyloid ligament—hip-joint formation, ii, 275.
Couching for cataract, ii, 121
Cough—causes and treatment, ii, 18, during feeding, ii, 4, 12; drugs, ii, 454, 461, 472, iii, 3, 5; prescriptions, iii, 15, 17. "Too sore to cough", and rest remedy, ii, 470, 471. symptoms of various diseases, i, 498, 501, 507, 509, ii, 2, 4, 8, 10, 12, 40, 51, iii, 149, unsoundness and warranty, iii, 421.
Counter-irritants—uses and examples, ii, 460, iii, 14.
Coupling of head and neck—various forms, i, 44–46.
Covered operation in castration, i, 321; iii, 175
Covered surface drains for stables, iii, 84–86.
Covering disease—(see Maladie du Coit).
Covert hacks—breeding, i, 140.
Cow-hocks—defect of conformation, i, 89; in harness horses and ponies, i, 151, 164; sprain due to, ii, 289; warranty, iii, 413.
Cow-pox due to grease disease, ii, 140, 141
Cow's milk for foal-rearing, iii, 224, 225.
Coxæ of pelvis—formation, &c., i, 58, 59, ii, 192, 274.
Coxo-femoral articulation, ii, 274, 275.
Cracked heels—causes, treatment, &c., ii, 423–425, iii, 68, 136; remedies for, ii, 456, 464, 474, 484; unsoundness, iii, 381.
Cracked hoof—term "sand crack" used for, ii, 365.
Cracked mouth and lips—cause, &c., i, 248.
Cracks of skin—causes, ii, 127
Cradle for fractures, &c., ii, 241; iii, 39.
Cramp due to lead poisoning, iii, 51.
Cranial nerves—names, structure and functions, i, 391–397
Cranium—formation and bones of, i, 8, ii, 183–186; iii, 403, fractures, ii, 234; muscles connection, ii, 184, 310, tumours on, i, 415, 417
Cream horses—origin, breeding, &c., i, 206, 207
Creasote—antiseptic and medicinal uses, ii, 485; iii, 4, doses, iii, 9; poisoning by, iii, 46
Creatinine from kidneys, i, 333.
Creation of the horse—history and theories, iii, 518, 525, 531.
Creation v. evolution—opinions, &c., iii, 482–484.
Crepitus for fracture detection, ii, 225; false crepitus, ii, 226, difficulties in ulna, sesamoid, and pelvis fractures, ii, 245, 252, 258.
Crest, arched—formation, i, 28.
Crib-biting—causes and correction, i, 413–415; iii, 327, 337, 343; troubles due to, i, 247, 272, 332; unsoundness and warranty, iii, 140, 424
Crico-arytenoid muscles—posterior and lateral forms, &c., ii, 317
Crico-pharyngeus muscle—form, &c., ii, 316.
Crico-thyroid muscle—form, &c., ii, 317.
Cricoid cartilage of larynx, i, 485.
Criminal offence—fraud and warranty of horses, iii, 411.
Crops preserved in green state—silage method, iii, 116–118.
Crossing of horses—see titles Breeding, Telegony—for special breeds see their names
Crotchets used in parturition, iii, 283, 284
Croton-oil—affecting bladder, i, 349; dose, iii, 9; poisoning by, iii, 46.
Croup—conformation and defects, i, 15, 58–60, 102; ii, 183; height measurements, &c., i, 93–95, iii, 288, 297; length influences, i, 97, 98; muscles, ii, 201, 339.
Croup disease causing asphyxia, i, 495.
Croup plexuses—nerves forming, i, 375, 378.
Crucial ligaments of stifle-joint, ii, 276.
Crura cerebri—formation, i, 383.
Cruræ of penis—form, ii, 70.
Crural nerve—formation, i, 402
Crural region—muscles, ii, 341–343.
Crushing the stone in bladder disorder, i, 365, 366.
Crust of the earth—formation, iii, 471, 472.
Crusta of teeth, iii, 494.
Crutch for parturition aid, iii, 283.
Cryptococcus causing epizootic lymphangitis, ii, 37, 59, 60, 61.
Cryptorchids—animals termed, i, 17, iii, 184; castration see that title
Crystalline lens of eye, ii, 105, 108, diseases affecting, ii, 117, 119, 120; soundness of, iii, 369
Crystals in blood hæmoglobin, i, 433; in urine, i, 345, 346.
Cubebs—dose, iii, 9.
Cubic air-space per horse—stable structure, &c., iii, 78–80, 81.
Cuboid bone—form, &c., ii, 204, 278
Cumberland Clydesdales—breed, i, 190.
Cunean tenotomy—position, &c., iii, 102, 168.
Cuneiform bones—of fore-limb or knee, ii, 193, 197; of hind-limb or hock, ii, 204; muscles insertion, ii, 344.
Cupped clot of blood, i, 436
Curb and its treatment, i, 60, ii, 300–302; hereditary, iii, 215; unsoundness and warranty, iii, 383, 384, 421.
Curb bits—types and uses, iii, 359.
Curby hocks—conformation and causes, i, 86, 60; ii, 301; unsoundness and warranty, iii, 413, 420, 421.
Curry-comb—a cause of crib-biting, i, 414, for mange, ii, 118, form for grooming, iii, 134, 135.
Curvator coccygis muscle—form, &c., ii, 326
Curve of back—conformation, i, 56, 57.
Curve of ribs—conformation, i, 64
Cushion bones—form and uses, iii, 487.
Cutaneous-piliferous growths from cornea of eye, ii, 118.
Cutaneous quittor—form, &c., ii, 379.
Cuticle of skin, ii, 124, 125; iii, 504, 505; wound-healing, ii, 405.
Cutis of skin, ii, 126
Cuts—a cause of disease, i, 220.
Cutting—a form of defective action, ii, 396–398; speedy cutting, ii, 400–402; injuries and prevention, iii, 455; soundness and warranty, iii, 420.
Cutting the bars of foot—effects, &c., ii, 435, 441.
Cyanide of mercury and gauze for wounds dressing, ii, 411, 412, 413.
Cystic calculus formed round stick, i, 370, 371.
Cystic ovary—form and removal, &c., ii, 78, 79, 102; iii, 183, 184, 229.
Cystic worms in intestines and liver, ii, 172–174.

Cystitis and its treatment, i, 340; unsoundness and warranty, iii, 423.
Cysts in capped knee, ii, 361; liver, i, 315; ii, 174; ovary, ii, 78, 79, 102; iii, 183, 184, 229.

D

Dale pony—appearance, &c., i, 169.
Damaged oats—recognition, iii, 347, 348.
Damp—diseases due to, ii, 1, 7, 20, 54, 55, 214; foal-rearing effect, i, 112; stable structure, iii, 326.
Dandruff—grooming of coat, iii, 135.
Dandy-brush for grooming, iii, 135.
"Danegelt" 174—hackney stallion (illust.), i, 38.
Danegelt strain—breeding prepotency, iii, 212.
Dappled horse—origin of markings, iii, 496.
"Darley Arabian"—history, crosses, and descendants, i, 111, 115, 128, iii, 547, 559.
"Dart" family of Cleveland bays, i, 129.
Dartmoor pony—history, breeding, and conformation, i, 163, 164
Dartmoor pony stallion "Goldfinder" (illust.), i, 190
Dartos of scrotum, ii, 67, 68; iii, 175.
Darwin on hereditary diseases, i, 217; on hybrid breeding, iii, 240.
Dead bone—poll evil effects, ii, 431, 432; sinus due to, ii, 428.
Dealer's condition — explanation of term, ii, 446, heart affections due to, i, 468.
Dealers and warranty laws, iii, 414-419; patent defects, iii, 413.
Death—of hired horses, liability, iii, 418 (see also Mortality).
Debility—causes of condition, i, 215, 216, 217; iii, 102; constipation and bowel disorders, i, 285, 296, 297; dropsy, i, 311; glanders and farcy, ii, 34; heart sounds in, i, 459; reproduction organs affected by, ii, 82, 83, 84.
Decayed teeth—treatment, &c., i, 330.
Deceit in sale of horses — warranty regulations, &c., iii, 409-411.
Decidua vera, reflexa, and serotina in uterus, iii, 253.
Decomposition — causes of disease, i, 224; antiseptics arresting, ii, 483; dilation of stomach a sign of, i, 277, wounds poisoned by, ii, 403.
Decoration of stables, iii, 319.
Deep flexor of foot—form, &c., of muscle, ii, 345.
Deep flexor tendon—operation, iii, 162.
Deep gluteus muscle—form, &c., ii, 339.
Deep muscles of neck and trunk—forms, &c., ii, 326.
Deep pectoral muscles — forms, &c., ii, 327.
Defective action and injuries from—dishing, i, 122; interfering (foot in contact with foot), brushing and cutting, ii, 396-398; overreach and forging, ii, 398-400; speedy cutting, ii, 400-402—shoes correcting, iii, 455-458; stringhalt or jerking limbs, ii, 395.
Defective ventilation — (see Ventilation).
Defects of conformation — (see Conformation).
Deformities—contraction of muscles and limb deformities, ii, 346, 347—operation for, iii, 168-171; cow-hocks, i, 80, 164; foals at birth, iii, 221; foaling difficulty, iii, 273; foot, i, 74, 75, 81; ii, 348, 393, 394; iii, 436, knees, i, 74, 75; ii, 304-305; parrot mouth, i, 331; rigs or cryptorchids, iii, 184, roach back, i, 57; unsoundness and warranty, iii, 375, 413, 419, 420. See also title Conformation and defects.
Degeneration of arteries and veins—diseases due to, i, 471, 475.
Deglutition of food—process, i, 234.
Delirium—due to brain inflammation, i, 400; indigestion, i, 271; rupture, i, 295
Delivery of foal—(see Parturition).
Deltoid muscle—form, &c., ii, 328.
Demulcents—medicinal uses, iii, 13.
"Denmark" 177—pedigree, i, 118.
Dental canal and nerves—formation, i, 293, 294; ii, 180
Dental operations, &c.—(see Teeth).
Dentata—see Axis
Dentine of teeth, iii, 404, 405
Deodorizers—preparations used, ii, 440, 457.
Deposits causing anæmism and heart disease, i, 465, 478
Depressant drugs acting on lungs and air passages, ii, 466, 470.
Depressor coccygis muscle—form, &c., ii, 320
Depressor labii inferioris and superioris—forms of muscles, ii, 308, 309
Depressor muscles—action and distinction, ii, 306, 307.
Derma of skin, ii, 126.
Dermatology—advances and classification, ii, 134, 136
Dermoid cyst—formation, &c., ii, 103.
Descent of the horse—(see History).
Development of organisms — evolution and other influences, iii, 479-484.
Development of the horse—(see Growth).
Dew-laden grass—horse-sickness caused by, ii, 54, 55, 58.
Dextrin in digestion, i, 244
Diabetes and its treatment, i, 346; warranty, iii, 423.
Diacetate of lead—medicinal uses, ii, 464.
Diagnosis of disease — definitions, i, 214, iii, 144, 145; general symptoms and examination, iii, 145-150; medicine and its use, ii, 442-444; skin diseases, ii, 135, 136.
Diagnostic symptoms of disease, iii, 144, 145.
"Diamond Jubilee"—descent, iii, 548.
Diapedesis process in blood, i, 434, 446.
Diaphoretics—uses, ii, 472; iii, 13.
Diaphragm or midriff—formation and uses, i, 16, 63, 491-494; ii, 337; paralysis of, ii, 235; rupture effects, i, 268; spasm of diaphragm, i, 312.
Diaphragmatic nerve — formation, i, 498, 549.
Diaphysis—growth of bone, ii, 178.
Diarrhœa and its treatment, i, 286-289; abuse of purgatives, i, 286, 289; diet errors causing, i, 218; drugs, &c., ii, 448, 450, 454, 455, 456, 457, 460, 465, 468, 480; iii, 1, 2, 3, 4, 5, 6, 7, 8; foals at birth, &c., iii, 222, 223, 227; hunters, in, 149; symptoms of various diseases, i, 272, 366, 471, 478, 479; iii, 149.
Diarthrodial joints—forms, ii, 262, 279.
Diastatic action in digestion, i, 244.
Diastema—formation and use, iii, 404.
Diastolic sound of heart in disease, i, 459, 460.
Dicrotic wave of heart, i, 449; diagram, iii, 148.
Diet—see titles Digestion, Digestive diseases, Food and diet.
Digastricus muscle—form, &c., ii, 313, 314, connection, ii, 310.
Digestion and Digestive System—Absorbent system influence, and fluids acting upon, i, 426, 427, 430.
Digestion and Digestive System—*Cont.*
Alimentary canal, its appendages and work in digestion, i, 229, 230; stomach and intestines, i, 234-238; liver and pancreas, i, 238-240
Blood supply and the influence of meals, i, 443
Condition balls and their effects, ii, 445, 446.
Digestibility and nutritive value of various foods—tables, &c., iii, 90-92, 96-101.
Diseases—see titles Digestive diseases, Gastritis, Indigestion, &c
Drugs assisting, ii, 474-478; iii, 1, 2, 7, use of acids, ii, 467.
Mixing of foods, and foods given first—effects, iii, 110, 116.
Processes of digestion—action of saliva, insalivation and deglutition, i, 230-234; gastric and intestinal processes, i, 244-247, medicinal treatment considerations, ii, 475.
[See also title Food and diet.]
Digestive Diseases and Injuries—
Choking and vomiting, i, 265-270.
Dilation and rupture of the stomach, i, 276-279.
Food and water a cause of disease, i, 215, 216; ii, 51; iii, 101, 102, 123.
Intestinal rupture and obstruction, i, 295-298.
Lips, mouth, tongue, and palate affections, i, 247-254
Parasites, &c., causing disease, ii, 51, 164-175
Poisons—effect of, iii, 46.
Rectum inversion, i, 301-303.
Salivation, or ptyalism, i, 258
Signs of disease—recognition, iii, 146, 149.
Stones, calculi, and other concretions—intestinal, &c., i, 298-301, salivary, i, 263-265
Temperaments liable to disease, i, 218.
Throat and parotid glands, i, 254-263.
Various diseases affected by digestive disorder — asthma, ii, 11; broken wind, ii, 13; filled legs, ii, 364, 365, herpes of skin, ii, 149, influenza, ii, 32; tuberculosis due to germs, ii, 51.
[See also titles Colic, Constipation, Diarrhœa, Dysentery, Enteritis, Gastritis, Indigestion, Liver, Superpurgation, Teeth.]
Digital arteries—formation, i, 450, 453.
Digital nerve—operation on, iii, 164.
Digitalin—medicinal uses, ii, 460.
Digitalis—medicinal uses, ii, 451, 460, 461; iii, 4; doses, iii, 9, 11; poisoning and antidote, iii, 50, 64
Digits and the evolution of the horse, iii, 286, 288, 476-478, 511, 512, 513; compared with hand of man, iii, 487-490; chestnuts as remains, iii, 500, 501, 507.
Dikkopaard-ziekte form of horse-sickness, ii, 55, 56, 57.
Dilatator nerves — influence on food, i, 443.
Dilation—of arteries, i, 477; heart, and sounds due to, i, 459, 460, 466; stomach—chronic dilation, i, 276.
Dilator for lithotomy, i, 363, 365
Dilator muscles—distinction, ii, 306; roaring due to, i, 510.
Dilator naris muscles—lateralis, anterior, superior, and inferior forms, ii, 308, 309.
Diluted acids — as digestive tonics, ii, 467, 468; medicinal uses of various acids, iii, 3, 6, 7; doses, iii, 9; as antidote, iii, 45.
Diluted liquid ammonia—uses, ii, 459
Diphtheria—bacillus and cure, i, 228; causing asphyxia, i, 435.

Diplococci formation, &c., i, 226.
Dipping of sheep poisoning effects, in, 47, 51
Diptera form of flies, ii, 163
Dirt cracked heels due to, ii, 424, 425; grooming out, iii, 134-137; wound-healing retarded by, ii, 403, 407, 410, 411, 416
Dirty water organisms in, iii, 127, 133.
Discharges astringents and alum uses, ii, 454, 456; broken knees, ii, 423; Coding, iii, 107; ulcers, ii, 406-408 See also title Blood-stained Discharges, Feet, Nose, Pus, &c.
Discus proligerus of ovum, ii, 79
Disease—
Alternate generation and effects, iii, 259-261
Definition and classification of causes, i, 213, 214; bacteria, &c., i, 224-227; ii, 160; exciting causes, i, 219-224; predisposing causes, i, 215-219.
Food and water effects, iii, 101-109, 123, 124-128
Resistance and recovery, ii, 443; use of hygienics, iii, 105, 140-144
Signs and symptoms; definitions of terms, iii, 144, 145; general symptoms, pulse, &c., iii, 145-156; infectious diseases, iii, 150-152; prevention and suppression, iii, 152-156.
Stable air; organic impurities causing disease, iii, 71-73
Unsoundness and warranty; list of diseases, &c., iii, 419-434, 435, 436 See also title Examination as to Soundness
Vivisection restrictions, ii, 443
[See also titles Contagious diseases, Diagnosis, Hereditary, Specific, &c., for special disease, see its name.]
Diseased animals see Sick Horses.
Dished face appearance of, i, 41, 54
Dishing faulty action, i, 122.
Dishonesty in sale of horses warranty regulations, &c., iii, 406, 411.
Disinfectants action and examples, iii, 113; activity in destroying organisms, table, &c., ii, 426, 427; antiseptic and other preparations used, ii, 449, 454, 455, 459.
Disinfection of stables, &c. foaling-box and parturition precautions, ii, 285; iii, 270, 274; foul dung, i, 292; horse pox, ii, 142; infected premises and clothing, iii, 24, 154-156; railway boxes, iii, 158, 160; skin diseases, ii, 150, 151, 165; wounds and instruments, &c., ii, 415; iii, 155
Dislocation or displacement of bones forms and treatment, ii, 479-489; accidental dislocation, ii, 481; fracture effects and distinction, ii, 222, 224, 226; patella dislocation, ii, 479, 481-483; shoulder slip, ii, 480; soundness and hereditary, iii, 435
Displacement of heart detection, i, 400
Distemper, a form of influenza, ii, 31; eye inflammation due to, ii, 115; St. Vitus' dance due to, i, 431
Distension of belly—causes, i, 283, 296.
Distomes causing liver diseases, i, 213, ii, 17, 171; development of, iii, 259.
Ditches animals in, extraction, ii, 459, 460; water causing disease, iii, 124, 125.
Diuretics and their uses, ii, 473; iii, 13; prescriptions, iii, 15, 17, 18; prohibition in diabetes, i, 347
Divine gift horse considered so by Arabs, iii, 533.
Divisions of a horse, i, 2-4; various views, i, 13, 14, 21, 22.
Documents on sale of horse—use in breach of warranty, iii, 420
Dog-tooth pea—poisoning by, iii, 58-60.
Dogs—cataract of eye, ii, 121, 122; foot-pads, &c., iii, 503, 507, 510; parasitic diseases of liver, i, 213-215; poisoning symptoms, iii, 47; tables, ii, 44; worms, ii, 174; Zadig and the lost dog—story of, iii, 475-475.
Domestication of the horse—history, &c., iii, 4-7, 517, 518, 521, 524, 526, 528, 529.
Doors of stables, &c.—structure, iii, 325, 334; ventilation by, iii, 74
"Dorothy Derby" J. and H. Wilson jumper, price, &c., i, 171.
Dorsal arteries formation, i, 444, 452.
Dorsal nerves structure, &c., i, 370, 371, 401.
Dorsal trapezius muscle form, ii, 522.
Dorsal vertebræ of spine, i, 13, 14; ii, 178, 179, 181; no coccyx, iii, 259, 260; chest connection, ii, 11, 12; fracture, ii, 276; muscles and connections, ii, 511, 512, 514.
Dorso-lumbar portion of supra-spinous ligament, ii, 274, 275
Doses—for various drugs, &c., iii, 9-12.
Double bridle use of, iii, 351, 359
Dourine disease see Maladie du Coit.
Dover's powder medicinal uses, ii, 472, iii, 5
Down at the hip causes, &c., i, 18; unsoundness due to, iii, 372, 373.
Drainage cause of disease, i, 222; ii, 24, 25
Drainage of stables see Stables
Drainage tube for lithotomy, i, 300; for wounds, ii, 411, 412.
Drain-pipe with flap for stables, iii, 325
Drains animals in, extraction, ii, 459-460
Dram physic balls—contents of, ii, 444
Draught bullocks for farm work, i, 175
Draught or Cart Horses—
Action in drawing a load, &c., i, 62, 63, 134, iii, 102.
Breeding and crosses, i, 153; ancient laws and early types, i, 173, 174, 175, 177, 178, 177, 186; crosses for Cleveland Bays, i, 147, 148, 149; hunters, i, 139, 140, 142; recent lines, i, 180.
Breeds suitable—Clydesdales, i, 184, 192, 193; Percherons, i, 205; Shires, i, 172; Suffolks, i, 194, 200.
Classification as heavy horses, i, 172.
Conformation—back and loins, i, 55, 57; breast and chest, i, 47, 48; canon, i, 70; croup, i, 50, 60; head and neck, i, 37, 40, 44, 51; height, i, 94, 95; hock, i, 83; limbs, i, 67, 68, 71, 83, 122, 123; pastern, i, 76; shoulders, i, 58, 62, 102; withers, i, 55
Diseases, &c., common to cart horses, i, 210; bog spavin, ii, 226; capped knee, ii, 360; cellulo-vaginitis, ii, 433; fracture of pelvis, ii, 286; lymphangitis, ii, 17, 18; malleoleus, &c., ii, 185; navicular disease, ii, 359; ringbone, ii, 205; ruptured stomach, i, 277; saddle-back, i, 305; side-bones, ii, 187; skin inflammations, i, 182; sore shoulders, ii, 428; sprains, ii, 204, 245, 247; thoroughpin, ii, 257
Food—amount required of, &c., iii, 347, 348, 349, 350
History and origin, iii, 535, 540, 543, 545, 549.
Physic ball for, ii, 445
Shoes for, iii, 441, 444, 447
Stable structure, iii, 323, 336
Teeth, illust., iii, 90
[For special breed, see its name.]
Draughts prescriptions and administration, iii, 18, 21; colic treatment, i, 284; pulmonary affections caution, ii, 9
Draughts in stables—prevention, &c., iii, 71-74, 80, 81, 361
Drenching—administration of the drench, iii, 21, 25; use in collapse, &c., ii, 440; for thrush, i, 251.
Dressings for wounds—antiseptics used, ii, 411, 412, 449-452, 453-455.
Dried bracken for bedding, iii, 357.
Dried food as diet, i, 341, iii, 198; grasses causing poisoning, iii, 62
Drinking water—(see Water).
Driving—defective action due to, ii, 400; fracture due to pulling-up suddenly, ii, 245; management of horses, iii, 340; rule of the road, &c., iii, 416; stabling opportunities, i, 351; warranty laws and accidents, iii, 417, 418, 434
Driving Horses—
Breeds suitable, i, 122, 131, 153, 207, 208, 209
Conformation—back and loins, i, 55; croup, i, 59, 60; height, i, 94; neck, i, 51; hock, i, 90; pastern, i, 80; shoulders, i, 59.
Training and action, iii, 12
[See also Carriage Horses, Harness Horses.]
Driving-reins use in training, iii, 105, 107, 314.
Dropping of foals—see Parturition
Dropping on lame leg action in, iii, 63
Dropsy and dropsical swellings abdominal or liver, i, 367, 380, 382; anæmia, i, 479; drugs used, ii, 471, iii, 4, 5; heart disease, i, 457; ovary disease, ii, 102; pleurisy, ii, 14; sheath, ii, 83, 84; wind-galls, ii, 355
Drowsiness—diseases indicated by, i, 401, 409, 422, 432, 434; poisoning causing, iii, 54
Drugs—see title Medicines and Drugs for special drug or disease, see its name.
"Druid The", on hunter qualifications, i, 138, 141
Drum appearance of belly—causes, i, 283, 296
Duct of Stenson—form of, i, 201.
Ducts—reproduction organs, ii, 65, 66, 67; salivary glands, i, 231, 232; stone in, i, 296; ureters, i, 333. See also Fistula, Parotid Duct.
Ductus arteriosus Botalli—formation, &c., i, 437, 448.
Ductus venosus and arteriosus in fœtus, iii, 256.
Dulcamara—medicinal uses, ii, 472.
Dung or Fæces, and Manure—
Concretions, internal—ordinary balls, form of, i, 300.
Drugs, ii, 447; iii, 14 see also Purgatives.
Expulsion—amount per day per horse, iii, 63; cause of pain, i, 274; foals at birth, iii, 270; involuntary escape, i, 419, 421; muscles connected with, i, 15, 16; ii, 536, 537.
Flattened appearance due to stone, i, 298.
Foul-smelling—disinfectants for, i, 292.
Obstruction of intestines, i, 297.
Removal by hand per rectum, i, 271, 284, 285; iii, 34.
Removal from stables—facilities, regulations, and storage, iii, 78, 82, 83, 320, 325, 335, 338.
Worms in, due to arteritis, i, 471.
[See also titles Constipation, Diarrhœa, Dysentry, &c.]
Dunpaard-ziekte—a form of horse-sickness, ii, 55
Dura mater of brain, i, 380, 384; thickening of, i, 417; of spine, i, 380.
Dust—air contamination, iii, 76, 77; broken wind and pulmonary disease precautions, ii, 13; iii, 24; eye affections, ii, 114; grooming of coat, iii, 134-137; laryngitis causes, i, 508.
Dutch forms of horse-sickness, ii, 55.
Dutch horses—British horse improvement, iii, 543, 544

Dwarfing of horses — evolution influence, iii, 286, 287.
Dynamical symptoms of disease, iii, 145.
Dysentery and its treatment, i, 299–302; drugs, &c., for, ii, 455, 474, iii, 1, 6
Dyspepsia—(see Indigestion).

E

Ear used for heart disease detection, i, 455, 459.
Ears bleeding, i, 501; conformation and bones near, i, 10, 42, 43; ii, 174, 185, 310; disease symptoms, i, 299; ii, 450, iii, 143; muscles and cartilages, ii, 310–312; nerves, i, 394, 395; swelling antiseptics, ii, 421, 450; temperament signs, i, 42, 43; twitch injuries, iii, 157. (See also title Hearing.)
Earth antiquity of, and existence of man on, iii, 517, 518; crust formation and animal remains, iii, 471, 472.
Eased heel in shoeing, iii, 446.
Eastern blood in hackney and packhorses, i, 115, 124; Percherons and Holsteins, i, 205, 209; thoroughbreds, i, 110, 111.
Eastern horses—history, &c., iii, 519, 527, 549, 550.
East Friseland breed of horse, i, 210.
Easton's syrup—medicinal uses, ii, 476.
Ecbolics and their uses, iii, 13
Echinococcosis of liver—causes, i, 314
Echinococcus veterinorum infesting liver, i, 297, 313.
Eclampsia and its treatment, i, 410
"Eclipse" history, &c., i, 109, 111, iii, 539, 547.
Écraseurs—castration, iii, 177, 175, 186; ovaries removal, iii, 181, 183
Ecthyma skin disease, ii, 150, 151; American horse-pox form, ii, 142.
Ecto-parasites, epi-, ento-, and endo-parasites—use of terms, ii, 160.
Ectropium and its treatment, ii, 112–114
Eczema and its treatment, ii, 146–148; drugs, iii, 1, 7, 8; mallenders, &c., a form of, ii, 157; recurrent nature, ii, 149; ringworm distinction, ii, 164; sore shoulders, ii, 435, 436.
Education in veterinary science, ii, 442
Efferent nerves—form, i, 374, 386.
Efferent vessel in kidneys, i, 336.
Egg bandages—uses, &c., iii, 38.
Eggs as invalid diet, iii, 25, 141; use as antidote, iii, 45.
Egyptian beans use as food, iii, 349.
Egyptian horses—history, iii, 519, 520, 525, 531
Eight-year-old—teeth, iii, 399, 400.
Ejaculatory duct of testicle, ii, 67, 69, 71.
Elaterium poisoning by, iii, 46.
Elbow and elbow-joint capped, i, 19; ii, 339; iii, 443; conformation and defects, i, 19, 71, 72; ii, 195, 196, 270; iii, 487; fractures, ii, 221, 245; height at, and growth measurements, i, 90; iii, 288, 294, 295–298; muscles, ii, 330, 331, 333; pyæmic arthritis affecting, ii, 287.
Elbow-pad—form, and uses, ii, 360.
Electric fan for ventilating stables, iii, 75.
Electricity—nervous stimulus, &c., use of, i, 386, 387.
Electuaries—drugs and administration, ii, 455; iii, 3, 18, 21; for mouth and throat, i, 250, 258, 508; for lungs, ii, 3, 9.
Ellesmere, Earl of—Shire horse prizes, i, 185.
Elliman's physic ball, ii, 445.
Eltham stud—history, i, 110.
Embolism—arteritis and atheroma symptoms, i, 471, 473; lung affection, ii, 140.
Embrocations—application, &c., iii, 42; mistaken uses, i, 249.
Embryo and fœtus—development, bone, and rate of growth, ii, 65, 76, 80, 178, 186, 192, iii, 249–257, 264, 288–295, 420–425; growth of chestnuts and ergots, iii, 504, 505, 506; removal of dead fœtus, and abortion treatment, ii, 62; iii, 207–209. (See also title Parturition—delivery, &c.)
Embryos of insects, &c.—alternate generation, iii, 270; evolution and other influences, iii, 470–483.
Emetics—restrictions for use, ii, 459
Emir Ibu Rashid Arab stud owned by, i, 101, 204, 205
Emmenagogues and their uses, iii, 13
Emollients medicinal uses, iii, 14
Emphysema and its causes, &c., ii, 12–14; heart disease connection, i, 469
Emprosthotonos tetanus form, ii, 47.
Emulsification of food in digestion, i, 241, 245, 249
Enamel of teeth, i, 295; iii, 494, 495.
Encephalic nerves forms, i, 371–397
Enclosure of the penis, ii, 81.
Endarteritis deformans—symptoms, &c., i, 472, 473, 478
Endemic diseases—classification and causes, i, 210, 223.
Endocardial murmurs in heart disease, i, 464.
Endocarditis and its treatment, i, 463, 464; ii, 42; joints affected by, ii, 280.
Endo-metritis and its treatment, &c., ii, 89, 97.
Endosteum in bone structure, ii, 176, 205
Endostitis a form of bone inflammation, ii, 208.
Endothelium of blood capillaries, i, 440; disease affecting, i, 472.
Enemas—see Injections.
Enemata medicine and food given by, iii, 17, 25
English Breeds of Horses—
Conformation, &c., of Cleveland bays, i, 125–133; hackneys, i, 113–123; hunters, i, 135–140; pack horses, i, 123–125; saddle and harness horses, i, 142–153; thoroughbreds, i, 107–113; Yorkshire coach horses, i, 133–135.
History on origin, &c., iii, 530, 535–550
(See also titles Cleveland Bays, Thoroughbreds, &c.)
Engorgement—see titles Liver, Stomach, Udder.
Enlargement of abdomen see Abdomen
Enlargement of glands of groin, i, 17.
Enlargement of heart—detection, i, 470; symptoms, &c., i, 465–467.
Enlargement of penis treatment, &c., ii, 82.
Enlargements—plasters or charges for reduction of, iii, 43.
Ensiform cartilage of breast-bone, ii, 190.
Ensilage as food preparation, &c., iii, 80, 115–118.
Enteritis and its treatment, i, 292–294; drugs for, iii, 6.
Entire horses—(see Stallions).
Entozoa development, ii, 480.
Entropium and its treatment, ii, 112.
Environment—influence on breeding, &c., iii, 280, 287, 479, 484, 548.
Enzootic diseases definition and causes, i, 213, 223.
Eocene formation horse origin, iii, 475, 509, 510, 513.
Eohippus fossil remains, horse origin, iii, 511, 512.
Epidemic diseases—classification and causes, i, 210, 223.
Epidermis of the skin, ii, 124, 125.
Epididymis of testis, ii, 65, 66.
Epigastric portion of abdominal cavity, ii, 3.
Epiglottis of larynx—formation, &c., i, 433; ii, 317.
Epilepsy and fits—causes, treatment, &c., i, 410; migrating distinction, i, 410; skin dressings effect, ii, 124.
Epiphyses of bone, ii, 177
Epistaxis—uses and treatment, i, 501, 503.
Epithelial cells of bladder, i, 337; of stomach, i, 285.
Epithelial lamellæ of horn, ii, 213.
Epithelium in wound-healing, ii, 405.
Epizootic diseases—definition and causes, i, 213, 223; covering disease as, ii, 52; list of, iii, 135.
Epizootic lymphangitis—bacillus and staining, ii, 59, 60; definition, causes, distribution, and diagnosis, ii, 57–61; symptoms and treatment, ii, 61–63; prevention of spread, ii, 63, 64; distinction from glanders and farcy, ii, 36, 37, 57.
Epsom salts medicinal uses, i, 297; iii, 4, 11; use as antidote, iii, 45
Equidæ or horse family—classification, iii, 475.
Equilibrium of a horse, i, 89, 371, 372; iii, 192.
Equine locomotion—see titles Action, Locomotion, Movements.
Equinia—a form of glanders, ii, 33
Equus asinus—special features, iii, 496.
Equus caballus—application of term, iii, 478; colour and marks, iii, 495; descent, iii, 513.
Equus quagga special features, iii, 496.
Equus zebra special features, iii, 496.
Erector coccygis muscle form, &c., ii, 326.
Erector penis muscle—form, ii, 73.
Ergot—medicinal uses, ii, 69, 463, 475; doses, iii, 19, 11.
Ergotin—dose, iii, 19.
Ergots of fetlock joint, i, 18, 21; ii, 132, 133, iii, 478, 500–502.
Eruptions—covering disease, ii, 52; lips and tongue, i, 247, 249; mouth, i, 240; soundness and detection, iii, 374. (See also Skin Diseases.)
Erysipelas—singeing-lamp causing, iii, 360.
Erythema and its treatment, ii, 142, 144, 145, 148; mustard or ammonia causing, ii, 143.
Eschar due to small pox, iii, 150
Escharotics acids used as, ii, 475.
Ether medicinal uses, ii, 459, 470, 474; iii, 3, 7, 8; doses, iii, 19
Ethmoid bone—form, &c., ii, 150.
Ethmoidal cells of sieve bone, ii, 180
Etiology definition, and causes of diseases, i, 214; skin diseases, ii, 138, 139.
Etruscan horse history, iii, 530.
Eucalyptus—uses, &c., ii, 471, 487.
European horses history, &c., iii, 534.
Eustachian tube formation, iii, 502.
Even-toed animals—classification, iii, 476.
Evergreens—poisoning by, iii, 55, 56
Evolution—
As natural process, and explanation of doctrine, iii, 478, 479, 481; objections and defence of theory, iii, 481–484.
Environment and other influences in development of ovum, iii, 255, 479, 480–483.

Evolution (*Cont.*
Fossil ancestors of the horse, iii, 500, 510, 511;
Generation and evolution, iii, 257–261, 286, 287.
Horse a favourite subject for evolutionist, iii, 435.
Jelly fish and origin of man, iii, 258, 479. 482, 483.
Observation and its power, iii, 470—story of Zadig and the lost dog, &c., iii, 473–475.
Rate of growth of horse, iii, 286, 287.
Shoeing of horses—history, iii, 429, 432.
Skin markings and colouring—influences, iii, 497, 499
Time required to produce visible changes, iii, 472–474
Ewart, Prof., on telegony, iii, 240, 241.
Ewe-neck—appearance, &c., i, 45, 47, 48, 49.
Examination as to Soundness, &c.—
Action, and wind, in, 374, 385
Defects of conformation and deformities, iii, 375
General examination and for eruptive diseases, iii, 372–374
Inspection by buyer—warranty regulations, &c., iii, 410.
Introductory, and preliminary observations, iii, 365–367
Special parts—eyes, nose, and mouth, iii, 367–370; head, iii, 370–372; legs and feet, iii, 376–380
Training considerations, iii, 301.
[See also title Warranty.]
Examinations for disease—eyes, ii, 103–111, general symptoms and eruptive diseases, iii, 145, 372–374, heart, i, 458–461. See also Post-Mortem.)
Excitement—as cause of disease, i, 215; heart rupture, i, 470; plethora, i, 480; show horses, iii, 313.
Exciting causes of disease—classification, &c., i, 214, 219; various causes and influences, i, 219–224; fractures and joints, ii, 222, 224, 279.
Excoriations on skin, ii, 137.
Excrescences—see Growths.
Excreta—see Dung and Urine).
Excretory ducts of testis, ii, 65, 66.
Exercise and exertion—air and blood influences, i, 490; cause of disease, i, 214, 216, 217, 222, indigestion, i, 272, rupture and spasm, i, 217, 413, 470, treatment of pregnant mares, iii, 264, ship-board horses, iii, 402, shoulder slip and lumbitis, ii, 351, 378, show horses, iii, 311, sick horses, iii, 141; trotters training, iii, 314–316; urine affected by exercise, i, 337.
Exmoor ponies—appearance, &c., i, 165, 166; Dartmoor cross, i, 163.
Exomphalus and its treatment, i, 316–318
Exostoses and their treatment, i, 417.
Expectoration—drugs, &c., used, ii, 5, 469, 470, 471; iii, 14; symptoms of pneumonia, ii, 8; tuberculosis, ii, 51.
Expiration of breathing, i, 492, 493; asthma difficulty, ii, 11; muscles assisting in, ii, 323, 324, 334, 335, 339.
Exportation of horses early prohibitions, i, 173, 174.
Expression of face, &c., as guide to temperament, i, 41.
Exsiccated alum and iron—medicinal uses, ii, 447, 450.
Extension in fracture setting, ii, 230, 233, sprain causes, ii, 280.
Extension movements in locomotion, iii, 104, 486
Extensor muscles—action, &c., i, 19, ii, 306; iii, 491, forms—brevis, ii, 344, metacarpi magnus and obliquus, ii, 332, pedis, ii, 332, 343, suffraginis, ii, 333, fracture effects, ii, 244, malformations, &c., due to, ii, 303, 304, 346.
Extensor tendons—forms, &c., i, 20; pedis tendons, ii, 332, 343, suffraginis, contraction causing deformity, ii, 346, 347, suffraginis tendon, ii, 333
Exterior of a horse—divisions, points, and names, i, 2–4, views, i, 13, 14, 21, 22, structure—genital organs, i, 17, 18, head and regions around, i, 4–12, lateral and inferior regions, i, 16, 17, posterior, anterior, and fore extremities, i, 15, 17, 18–22, posterior or hind limb, i, 22, upper body or top line, i, 12–15.
External carotid artery—form, i, 451.
External deep ligament of hock joint, ii, 378.
External flexor of metacarpus—muscle form, ii, 331.
External genital organs—see title Reproduction Organs.
External iliac artery—form, i, 452.
External intercostal muscles—form, &c., ii, 334
External oblique muscle of abdomen, ii, 335, 336.
External popliteal nerve—form, i, 463.
External respiration—form of, i, 453.
External saphenous nerve—formation, i, 404.
External tuberosity of humerus, ii, 194.
Extinct horses—remains and history, iii, 471–484, 509–513, 517–520
Extracts of various drugs—doses, iii, 10.
Extravasation of blood—a form of hemorrhage, i, 501, 502, ii, 150.
Extremities of a Horse—
Blood supply to nerves, i, 380.
Coldness due to disease, iii, 143.
Diseases affecting—bone diseases, ii, 210, 211; fractures, ii, 225; joints, ii, 279, mange, ii, 107; sprain, ii, 280.
Names and structure, i, 2, 3; bones, ii, 177, 178; fore extremity and muscles, i, 18–22; ii, 328–333; head region, i, 4–8; posterior and anterior extremities and limb, i, 15, 16, 22.
Extrinsic causes of disease, i, 214, 215, 220
Eye and Eyelids, &c.—
Dirt and injuries—first aid, &c., ii, 439; iii, 157.
Diseases—see titles Eye diseases, Eyelid diseases.
Drugs and lotions, &c., ii, 454, 456, 457, 463, 464, 481, 483; iii, 14; quinine impairing sight, ii, 451
Examination of, i, 11; ii, 103, 109–111; for soundness and warranty, iii, 367–370, 422.
Head position, &c., affecting sight, i, 45, 46; iii, 78, 82.
Influence of sight on breeding, &c., iii, 407.
Parasites infesting, ii, 175.
Poisoning symptoms, iii, 47.
Structure, i, 8, 11—divisions, muscles, and movement, ii, 103–105, 308, choroid tunic and ciliary processes, ii, 105, 106, 107; humours and lens, ii, 107, 108; iris, pupil, and retina, ii, 106, 107; nerves, i, 383, 385, 391, 392, 393; ii, 104, 105, orbit, haw, sclerotic, cornea, and lachrymal duct, ii, 103–105, 107, 108, 167.
Temperament judged by, i, 41.
Eye diseases, &c.—air and light in stables, i, 45, 46; iii, 78, 82, 142; bleeding from, ii, 115, cocaine for operations, ii, 110, cold of eye, i, 497; defective sight, i, 43, 270, ii, 104, 451.
Eye diseases—(*Cont.*
examination for disease, unsoundness, and warranty, i, 11; ii, 103–111; iii, 367–370, 422; fracture effects, ii, 238; glaucoma and removal of iris, ii, 123, 124 hereditary effects, iii, 215; pink eye, ii, 51, retraction in tetanus, ii, 45, seeds in eye, removal, iii, 157, tear duct and watery discharges, ii, 56, 114 See also Blindness, Cataract, Conjunctiva, Cornea, Ophthalmia.
Eyelid diseases, ii, 111 laceration and abscesses, ii, 112, inflamed and inturned, ii, 112–114 loss of lashes, &c., ii, 111, spotted with blood, ii, 25 swellings, ii, 52, 114
Eye-teeth—appearance and origin, i, 332; iii, 329, 390, 497.

F

Face and facial region—conformation, forms, and bones, i, 5–41, ii, 183, 187–189, iii, 493, diseased bone, ii, 215, 216, examination for soundness, iii, 371; fractures and injuries, ii, 233, 452, markings and blaze, iii, 476, 492, muscles, ii, 307–310, nerves, i, 392, 393, 394, ponticing, ii, 39, 325, swellings, i, 476; ii, 24, trephining, i, 509, 591.
Face cradle for fractured jaw, ii, 241.
Facial nerve centre and nerves—functions and origin, &c., i, 232, 233, 382, 385, 394
Facial paralysis and its treatment, i, 422, covering disease effect, ii, 53.
Fæces—see Dung
Fainting—see Collapse.
Fairs and the law of warranty, &c., iii, 417
Fallen horses first-aid directions, ii, 441.
Falling of the hips—causes, i, 15.
Fallopian tubes formation and obstruction, ii, 77, 80, iii, 229.
False auchylosis—form of, ii, 281.
False nostrils—origin, form, and uses, i, 10, iii, 508.
False quarter causes, iii, 437, unsoundness and warranty, iii, 379, 422.
False ribs—formation of, ii, 191
False statements in sale of horses—warranty and fraud, iii, 410, 411.
False vertebræ—form, ii, 170, 180.
Fans—for stable ventilation, iii, 75.
Farcin de bœuf similarity to epizootic lymphangitis, ii, 60, 61
Farcy—appearance illust., ii, 1, distinction from glanders, ii, 33, 36, from epizootic lymphangitis, ii, 59, 61; unsoundness and warranty, iii, 422. See also title Glanders and farcy.)
Farcy buds—formation, &c., ii, 60.
Farm horses—see Agricultural horses).
"Farmer's Glory"—type of Cleveland Bay, i, 129.
Farmers early breeding of horses, ancient laws, &c., i, 173, 174, 180, 188, 189, hackney and hunters breeding, i, 113, 114, 130, 142; sale of horses and warranty laws, iii, 414.
Farmyard ponds—water effects, iii, 130.
Farriers—Worshipful Company foundation, &c., iii, 439
Fascia loose in wounds, removal, &c., ii, 433; symptoms of fistulous withers, ii, 433, 434.
Fast traveller—Morgan horse as, i, 207.
Fastening of horses—during transit, iii, 404–406, for operations, iii, 157; in stables, iii, 328, 406
Fasting before operations, iii, 162.
Fat-forming glands of skin, ii, 125, 126.

Fatigue causing sprain, ii, 354.
Fats—in blood and body, i, 435; iii, 87; in food and digestion, i, 241, 246; iii, 89, 90, 97, 98, 100.
Fattening of animals—(see Conditioning).
Fatty disease of heart—degeneration and infiltration, i, 467, 468–470
Fatty liver and its treatment, i, 308.
Faults see titles Conformation and defects, Defective Action, Vices.
Feather—on Clydesdales, i, 192; Shires, i, 161, 183; Suffolks, i, 197.
Features peculiar to a horse—special structure, iii, 404–407
Febrifuges—(see Antipyretics).
Feeding—see Food
Feelers on lips and nostrils, i, 5, 9.
Feet—
Conformation, &c., i, 21, 22, 81, 82; ii, 199; compared with man, iii, 427–499; for shoeing, iii, 433–438; horny growths and pads, iii, 501–504, 506, 508; joints and ligaments, ii, 273, 274; model of hoof, &c., ii, 401; muscles, ii, 332, 333, 343, 345
Evolution and fossil remains—five toed horses, &c., iii, 280, 476–477, 479, 491, 511, 512, 513.
Grooming and healthy condition, iii, 67, 68, 135–137, 154.
Putting into manger—correction, iii, 342
Soundness and warranty, iii, 367, 372, 378, 379, 386, 420, 421, 422
Unnerving precautions, &c., iii, 161, 164, 165.
(See also titles Hoof, Pastern, Shoes.)
Feet Diseases and Injuries—
Defective action causes, &c., ii, 396–402
Deformities, contracted feet, &c., i, 81, 82, 84, 99; ii, 340, 347, 345, 393–418; iii, 168, 430, 440; sprain liability, ii, 289.
Discharges caused by various diseases, ii, 373, 374, 379, 381, 393, 384, 425, 426
Disqualifying ailments for sires, ii, 302.
Fillings in crust—detection, iii, 386, 410
Moss-litter effects, iii, 135, 139.
Poulticing directions, iii, 30, 31.
Pricks and wounds, ii, 210, 380, 381, 385–387, 413, 414, 428.
Soundness and warranty—see Feet
Various diseases—fever in the feet, ii, 370–378; horn tumour, ii, 372; sand crack, ii, 365–367; shelly feet and seedy toe, ii, 367–371; side bones, ii, 387.
(See also titles Canker, Corn, Cracked heels, Lameness, Navicular disease, Quittor, Thrush, Vilitis.)
Feetlock—meaning of term, i, 21; iii, 501.
Fell pony—appearance and cross, i, 169, 171.
Female genital organs—(see title Reproduction)
Femoral artery—formation, &c., i, 455
Femoro-tibial joint and ligaments, ii, 275–277.
Femur bone—conformation, i, 22, 83, 85; ii, 201; fracture, ii, 220, 260; joints, ii, 274, 275–277; muscle connections, ii, 339–341, 342, 344–345.
Fences—jumping methods, iii, 201.
Fenugreek—medicinal uses, iii, 15, 17
Fermentation—a cause of disease, i, 210, 221, 223; in stomach, i, 270—drugs for, ii, 455; influence of bacteria, i, 227
Ferments produced in digestion, i, 234, 238, 244, 245.
Fetlock and Fetlock-joint—
Conformation and defects, i, 21, 75, 76, 79; ii, 199, 200; malformations, ii, 346, 347, 347; ergots, i, 18, 21; ii, 142, 143; iii, 472, 500–508; muscle connections, ii, 332, 333, 343, 345
Fetlock and Fetlock-joint *Cont.*
Diseases and injuries affecting, ii, 60, 229, 280, 301, 366; bandages and poulticing, iii, 31, 36; fractures, ii, 251, 252; ‘ loughing,’ iii, 103; sprains, ii, 294, 295, 297, 298, 355; wind-galls, ii, 355, 356
Examination for soundness, iii, 377, 380.
Foot striking—due to defective action, ii, 396, 397; iii, 455, 456.
Knuckling over causes, &c., ii, 207, 298
Operation of unnerving, iii, 161, 164.
Fever—ailments due to, i, 254, 274, 468, ii, 34, 56, 57, 374; drugs, &c., ii, 451; iii, 7, 8, 15, 17, 18; food and appetite, iii, 141; poisoning and pasturage effects, iii, 48, 75; pulse indications, iii, 147, 148. (See also titles Contagious diseases, Infectious diseases, Temperature, for special fever, see its name.
Fever in the feet and its treatment, ii, 370–378, other causes and effects, i, 200; ii, 368, 369; iii, 109, unsoundness and warranty, iii, 422.
Fibres—bone structure, ii, 208; muscle structure, ii, 305, 309; rupture due to sprain, ii, 292; nerve fibres see that title.
Fibrillæ of muscle, ii, 305.
Fibrine of blood in powder for sick horses, iii, 141.
Fibrinogen in blood, i, 435, 436.
Fibro-cartilages joints structure, ii, 195, 199, 273, 275; loose cartilages around joints, ii, 284, 285.
Fibroma and its treatment, ii, 155.
Fibrous tissue, &c. aneurism causes, i, 478; joint disease, ii, 281; liver capsule rupture, i, 309, 310; sheath of tendons, ii, 306; testicle structure, ii, 66, 67; wound-healing process, ii, 495
Fibula conformation, i, 23, 85; ii, 203, 205; muscles connection, ii, 343, 344
Fields disinfection, ii, 156. (See also Land, Pasturage.
Filaria causing disease, ii, 174, 175.
Filled legs—causes, treatment, &c., ii, 364; iii, 39, 402, 403, drugs, iii, 6; unsoundness, iii, 380
Fillings on foot detection and fraud, iii, 389, 410.
Filters for rain-water, iii, 236.
Fingers of man comparison with foot of horse, iii, 487, 499, 500, 501
Fireplaces and fires—stable structure and ventilation, iii, 74, 332
“Fireway 249” pedigree, i, 123.
“Fireway” West’s and Read’s—records, i, 116, 117
Firing advantages, methods, and instruments, iii, 166, 167, for castration, iii, 173, 174; sprains, ii, 294, 298, 297, various affections, ii, 242, 290, 291, 302, 350, 366, 372, use of drugs, ii, 455, 457, iii, 166.
First-aid to sick and injured—articles useful in, ii, 426, 430, bleeding and its arrest, ii, 427–431, collapse, fallen and runaway horses, ii, 440, 441; horses in ditches, &c., ii, 439, 440, poisoning, iii, 44, 46.
First inter-phalangial articulation, ii, 273
First phalanx of fore limb, ii, 198.
Fissure of spinal cord, i, 381, 382
Fistula—causes and treatment, i, 261–263; ii, 429, 430, disinfecting fluid for, ii, 426.
Fistulous wounds and their treatment—poll evil, ii, 430–432, quittor on coronet, and fistulous withers, ii, 378, 379, 432–435, shoulders, ii, 435, 436—drugs for, ii, 449, iii, 2, 4.
Fit condition meaning of term, ii, 44
Fits—choking causing, i, 266, epileptic and apoplectic fits, i, 406, 414, unsoundness and warranty, iii, 422.
Five-toed animals horse evolution, &c., iii, 476, 479–478, 489, 491, 505, 511.
Five-year-olds—hunters work, iii, 199; teeth of, iii, 389, 392, 395, 398, 399.
Fixed joints—formation, ii, 270.
Flanders—heavy horse breeding, &c., i, 173, 175, 176, 177, 178; iii, 530, 549.
Flank—conformation, i, 15, 17, disease effects, i, 17, 312, 329, muscles, ii, 335, 337.
Flannel bandages for muddy legs, iii, 136, sick horses warmth, iii, 143.
Flaps—in stable drainage, iii, 229
Flat bones description, &c., ii, 177, 178.
Flat feet—shoeing, iii, 449, 445, 453, 454
Flat-worms—in intestines, ii, 162, 172–174.
Flatulence—due to broken wind, ii, 15; indigestion, i, 273, liver disorders, i, 303, 307 drugs for, ii, 405, 409, iii, 1, 2, 3, 7, 8
Flatulent colic and its treatment, i, 281–284; drugs, ii, 459, 455, iii, 6.
Fleam—use causing thrombosis, i, 475, 476.
Fleming’s tincture of aconite dose, iii, 11
Flemish horses—hackney and pack horse breeding from, i, 115, 124; Shires and Clydesdale crosses, i, 179, 186, 187, 188, 189
Fleshy head—appearance, &c., i, 37
Flexion movements in locomotion, iii, 104, 486.
Flexor muscles—action, &c., i, 19, ii, 306, iii, 104, 401, bowed knees and malformations due to, ii, 391, 394, 349.
Flexor muscles forms, &c.—brachii, ii, 105, 9, spram of, ii, 292, 293; brevis, ii, 342; metacarpi internus, medius, and externus, ii, 339, 331, metatarsi muscle, ii, 343, 344, sprain, &c., ii, 299, pedis accessorius muscle, ii, 345; pedis perforans muscle, ii, 338, 345, iii, 103, pedis perforatus muscle, ii, 331, 344.
Flexor tendons perforans and perforatus—forms, i, 19, ii, 331, 332, conformation of canon and fetlock, i, 75, 76, 77, 79, contraction causing deformity, ii, 349, curb causes, ii, 300; navicular fracture and disease effects, ii, 252, 253, 259, 262, iii, 103, operation for division, iii, 165, 171, pricks and wounds affecting, ii, 385, sprain of tendons, ii, 297, wind-gall causes, ii, 355, 356, weight effects, ii, 72
Flies—horses infested with, ii, 163.
Floating bones form and uses, ii, 198, iii, 4, 7, 458
Floats for horse-transit, iii, 474
Flood, The Chinese history on, iii, 517.
Flooding in mares, ii, 87–89
Floors for stables, iii, 69, 70, 229, 234, 237, 325, drainage, iii, 54, 70
Flowers of sulphur uses, ii, 455.
Fluid measure for medicinal uses, iii, 11.
Fluids digestive juices, &c., i, 235, 245, 249, eye humours and disease, ii, 107, 109, 113, horse sickness, ii, 369, joint diseases and sprains, ii, 283, 297, in muscles and tissues, ii, 273, in ovary and womb, ii, 79, 91, pleurisy symptoms, ii, 14, 15, 17, skin, ii, 121, absorption and poisonous action on skin of certain fluids and micro-organisms, ii, 122, 133, 136. See also title Discharges.
Fluke-worms causing disease, i, 313, 315, ii, 162, 173, 174, generation of, iii, 280, 479.
Flushing of stable drains, iii, 61, 67, 232
“Flying Childers” descent and history, iii, 542, 547.
“Flying Fox” illust. of thoroughbred, i, 111.

Flying jumper - methods, iii, 200.
Flying trot - action of, iii, 105.
Foaling - box - cleansing and heating, &c., ii, [illegible], iii, 227, 228, 265
Foals -
Ailments and diseases common to - aphthæ or thrush, i, 250–252, bowed knees, ii, [illegible]–315; constipation, i, 284, 285, diarrhœa, i, 280, 288, hernia and trusses for, i, 310, 307, 322, hoofs - overgrown, iii, 4, 6, intestinal obstruction, i, 279, joint ill, i, 308, ii, 120, liver inflammation, i, 295, 300, patella - dislocation, ii, 352, pyæmic arthritis, ii, 257–260, rectum plugging, i, 284, 285
Birth of - appearance and care at, iii, 259, 261, 270, 275, natural delivery and malpresentations, iii, 261–264, premature foals, iii, 221, 267, size measurements, iii, 294, 297, "slipping the foal", iii, 275–280, when foals should fall, iii, 255, ponies, i, 155, 156
Food - artificial after birth, i, 282, iii, 287, foster mothers, i, 277, iii, 222, hand-rearing and weaning, use of cows' milk, &c., iii, 222–226, 285 - see also Suckling.
Growth of - rate before birth, iii, 243–257, 261–264, 288–295, after birth, iii, 294–298
Navel-string - immediate dressing, ii, 276, iii, 263
Teeth - temporary and milk teeth, iii, [illegible]–300
Thoroughbred rearing - conditions, &c., i, 107, 112, 113.
[See also titles Embryo and fœtus, Parturition and Pregnancy.]
Foam at mouth - due to bleeding lungs, ii, 10, bone disease, ii, 213, fits, i, 416, 418, horse-sickness, ii, 30, poisoning, iii, 47, salivation, i, 251.
Fodder - see Food.
Fodder-room - structure, &c., iii, 333.
Fœtal membranes - formation of, iii, 250–255.
Fœtus - see title Embryo and fœtus.
Follicles of ovary, ii, 73, 79.
Fomentations - see Hot applications.
Fontana, canal of - in eye, ii, 108.
Food and Diet
As cause of disease, i, 214, 215, 216, 221, 222, ii, 31, iii, 301–306 - damaged fodder, ii, 216, 47, medicine in - judicious dieting, ii, 442 - See also title Food Errors
Body needs and constitution—table, &c., iii, 87.
Chewing and manner of eating—time, &c., i, [illegible], 247, 250
Choking prevention, &c., i, 4 to ii, 17.
Cleanliness in stable - removal of food, &c., iii, 67, 111
Composition, assimilation, and functions of various foods - tables, &c., i, 241–244, iii, [illegible] 92, 96–101, 115, 116
Digestibility and nutritive value of various foods - tables, &c., iii, 99–102, 106–110, 112, 113
Digestion process - action of saliva, &c., i, 230–234, food in stomach and alimentary canal, &c., i, 234–238, 240, 247 - processes of digestion, i, 244–247 - of various foods, iii, 115, 116
Effect of food on blood, i, 412, 413, 443, ii, 447, lacteal system, i, 429, 437, respiration, i, 430 - "stone" formation, i, 292, 299, urine, i, 538, 539.
Errors in feeding - see title Food Errors.
Feeding system - amount per day and arrangement of diet, i, 231, 241, 243, iii, 91–95, 176, 347, choice and preparation of food, iii, 106–118,
Food and Diet - *Cont.*
Feeding system - *Cont.*
conditioning foods, ii, 446, cooked food, iii, 349, 359, green foods, iii, 95, 351–354, mixed diet, need, iii, 343–345, 349, oats and hay only, iii, 349, steam power for cutting up foods, iii, 337, various grains, &c., used, iii, 347–351 - See also subheadings Special diet, for special food, see its name.
Fracture causing feeding difficulty, ii, 240.
Rectum - food injections by, i, 253.
Special diet for diseases - broken wind, ii, 12, constipation, ii, 442, gastritis, i, 277, 278 - tetanus, ii, 450, use of arsenic, cautions, ii, 45
Special diet for hungry horses, i, 264, ponies, i, 155, 156 - sick horses, iii, 25–28, 349–442, before operations, iii, 16, 17, 19, 164 - ship horses, iii, 403, Shires, i, 151, show horses, iii, 406, 411, sires, iii, 335, Suffolks, i, 147, training, iii, 178, 196. See also titles Breeding, Mares.
Wild horses - natural food, i, 241.
[See also titles Digestion, Indigestion, Pasture, Water, for special food, see its name.]
Food Errors and Improper Feeding
As causes of disease, i, 214, 215, 216, 217, 221, 222
Bedeeting - prevention, iii, 130, 208, 365, 411
Diseases influenced by—anæmia, i, 478, broken wind, ii, 12, 13, bog spavin, ii, 296, 301, colic, i, 282, constipation, i, 284, 285, dilatation of stomach, i, 276, diarrhœa and dysentery, i, 280, 291, filled legs, ii, 364, gastritis, i, 276, glanders and farcy, ii, 34, hæmoglobinuria, ii, 20, 291, heart affections, i, 476, 479, laminitis, ii, 376, liver disorders, i, 293, 295, 300, 301, lymphangitis, ii, 52, œdema of sheath, ii, 344, plethora, i, 440, rheumatism, ii, 201, skin disorders, ii, 138, 139, 143, 145, 149, thoroughpin, ii, 358.
Gorged food - antiseptic treatment, ii, 485.
Medicine in - judicious dieting, ii, 442
Poison by food-stuffs, &c. - see Poisons
Foot - see Feet.
Foot and mouth disease - cause, &c., i, 221.
Footlock of fetlock, i, 21, iii, 191.
Footprints of various paces, iii, 107, of animals on rocks, &c., iii, 172.
Foot surface of shoes, iii, 442
Foramen dextrum and sinistrum of diaphragm, ii, 57.
Foramen lacerum at base of skull, i, 451.
Foramen magnum - cranium formation, ii, 134
Foramen of Monro - brain structure, i, 4
Foramen ovale - formation, iii, 250.
Force - as aid in feeding, ii, 234, in training, iii, 201–203, 204
Forced respiration - conditions, i, 434, high blowing due to, ii, 19.
Forceps - for castration, iii, 173, 174, 175, 205, for foaling, iii, 284, lithotripsy or "stone", i, 304, 307, sand crack, ii, 295, tenotomy, iii, 169, wire cutting, ii, 419, 420
Forcing - see Conditioning.
Forearm - conformation, defects, and bones, i, 69, 71, 72, 100, ii, 194, 195–197, disease, due to spavin, ii, 297 - dislocation, ii, 350, fracture, ii, 244, 246 - joint, ii, 187, muscles and connections, i, 69, 72, 73, ii, 187, 324, 333
Fore extremities - conformation, i, 3, 18–22, muscles, ii, 326–333
Forehead - conformation and defects, i, 8, 18, 39, temper signs, i, 41, 42, muscles attached to ear, ii, 311. Poll evil, see that title.
Fore-Limbs -
Action - in drawing a load, i, 65, 81, defective action and injuries, ii, 396–402.
Blistering, iii, 19.
Conformation, defects and bones, i, 18–22, 67–81, 100, ii, 192–195 - of forearm bones, ii, 195–197 - of metacarpal and other bones, ii, 197–199, compensation for defects, i, 101, special structure and comparison to man, ii, 475–477, 491.
Diseases - see title Limbs - diseases and injuries.
Fractures of various bones, ii, 243–244–247–247–254–255–259, bandaging for, ii, 242–244, iii, 37, iron splint for, ii, 247
Functions of the limbs, i, 67.
Growth before birth, iii, 260–264, after birth, iii, 294–297.
Lymphatic vessels of, i, 420
Nerves, arteries, and muscles, i, 69, 447, 449, ii, 189, 326–333, iii, 491, illustr., i, 69, 326.
Soundness - examination, iii, 57–59
Strapping up in operations, iii, 157
Tendons and ligaments, i, 69, ii, 222, 223.
Weight of body distribution, i, 91, 92.
Foreign Bodies -
Diseases, &c., due to - colic, i, 270, eye inflammation, ii, 111, 114, gastritis, i, 274, heart inflammation, i, 464, 466, laryngitis and spasm of larynx, i, 507, ii, 17, penis affection, ii, 63, sinuses, ii, 422.
Removal and results - cautions, ii, 47, in tongue or throat, i, 532, 555, wounds, ii, 415, 416, 418–430.
[See also titles Calculi, Stone.]
Foreign breeds of horses - see titles Arab, East Friseland, Hanoverian, Holstein, Morgan, Oldenburgh, Percheron, Schleswig, &c.
Forelock of head, i, 4
Forfeited shoes - history, iii, 440
Forging as defective action, ii, 399, 400, iii, 437
Forks - wounds caused by, ii, 413.
Fossil horses - history of, iii, 263, 267, 268, 472, 475, 476, 478–481
Fossilized teeth - identification of animals, iii, 492, 494
Fossils - meaning of name, iii, 472
Foster-mothers - use and effects, i, 277, iii, 222.
Foundation stock - for breeding, iii, 330–331.
Founder - a form of unsoundness, iii, 422
Four-off - age indications, iii, [illegible]
Four-year-olds - hunter training, iii, 200, mouth, iii, 18, teeth, iii, 307
Fowler's solution of arsenic - various uses of, i, [illegible], ii, 142, 150, 453
Foxglove - medicinal uses, ii, 460, poisoning by, iii, 50
Foxy oats causing disease, iii, 304
Fractures or Broken Bones
Bandaging of various fractures, ii, 242–244–244–245, 247, 249, 250, 253, iii, 43
Causes, and the influence of age, violence, &c., ii, 222–224
Diseases of joints due to, ii, [illegible]
Distinction from displacement or dislocation, ii, 222, 226, from sprain, ii, 226
Forms and general symptoms and treatment, ii, 221, 222, 242–243
Particular fractures, and special treatment - compound fractures, ii, 253, 254 - face and frontal bones, ii, 238, maxillary bone, ii, 242, skull, ii, 234,

Fractures or Broken Bones— *Cont.*
Setting procedure, II, 228–233.
Teeth—treatment, I, 330; II, 239–242.
Vertebræ or spine, II, 235, 239—sprain distinction, II, 208
[For special bones see their names, as Jaw, Pelvis, Ribs, Ulna, &c. also titles Fore-limbs, Hind-limbs.]
Fraud in sale of horse - legal offences and warranty, III, 408, 409–411.
Free-moving joints—form, &c., II, 262, 279, disease, II, 279, 282.
French breeds of horses, I, 205.
French suture needle for wounds, II, 419.
Frenzy due to brain inflammation, I, 306, 407, to "staggers" or indigestion, I, 268, 271; to parturition, III, 274.
Friar's balsam—various uses, I, 248, II, 3, III, 2.
Fright control of horses during, II, 437.
Frœnum of tongue, I, 7.
Frog of foot —anatomy, III, 434, 437; canker, II, 381, navicular disease affecting, II, 392, paring evils, II, 368, 373, 374, 394, preparation for shoeing, III, 439, 441, pricks and wounds to, II, [illegible], removal effects, II, 341, unsoundness, III, 381, 382.
Front limbs—(see Fore-limbs).
Frontal bones of cranium, II, 136; fracture, II, 238, muscles attached to, II, 308 (see also Face).
Frontal cranial nerve—form, I, 393.
Frontal sinuses—form, I, 8, II, 180; fracture effects, II, 238, 239.
Frost-bites causing quitter, II, 379.
Frost-nails used in shoeing, III, 451
Froth —(see Foam at mouth
Fulcrum in locomotion, III, 101, 104
Fullered fore-shoes—method, III, 445, 447.
Fumigation — see title Inhalation and fumigation.
Fundus of bladder—stone in, I, 358, 359.
Fundus of eye—appearance, II, 110
Fungi—as cause of disease, I, 224, II, 101, by food, III, 102–104, digestive system parasites, II, 169–175, ringworm due to, II, 105, water pollution, III, 120–124.
Fungous growths on feet, II, 365, [illegible].
Furniture of harness-room, III, 332.
Furred tongue due to liver, I, 301
Furrow of torsion in humerus, II, 104, muscle connection, II, [illegible].
Furunculus—a skin inflammation, II, 159.

G

Gag—fractured jaw due to, II, 239; physic given by, III, 20.
Gag-bit—use of, III, 350.
Gait —see Action
Gaits, shortened compensating points, I, 103.
Gall-bladder not present in a horse, I, 240.
Galled back—cause of, I, 220.
Gallic acid —medicinal uses, II, 455; III, 10, as antidote, III, 51.
Galloping—equilibrium, action and forms, I, 80, 82, 84; III, 102, 107, 108, in training, III, 190, 305, 306, crump formation, I, 58, poisoning effects, III, 54; respiration effects, I, 401, results or diseases due to, II, 17, 19, 219, 351, 398, 490.
Galloway horses—Clydesdale breeding from, I, 187, 189, 193
Galloway pony wager won by Mr Sinclair, I, 169.
Galvayne's teeth and age test, III, 401
Gamboge —poisoning by, III, 40
Game-hunting horses — prevention of horse sickness, II, 58.
Games, ancient—uses of horses, III, 522, 526, 527
Ganglia—brain structure and functions, I, 373, 390, cranial nerves, Gasserian, Andersch's, and jugular ganglion, I, 393, 395, heart structure, II, 488, semilunar or solar ganglion of dorsal nerve, I, 377, spinal nerves, I, 397, sympathetic nerves, I, 374, 375
Gangrene—of mammary gland, II, 15, 90, penis and sheath, II, 83, vaginitis and parturient fever causes, II, 91, 92
Gangrenous pneumonia due to influenza, II, 32.
Gargles and their uses, III, 41, drugs for, II, 454, 455, III, 2, 3.
Gases—or and water pollution, &c., III, 118, 82, 121, 126, 127, 133, causing asphyxia and poisoning, I, 404, III, 45, colic, I, 276, 281, 283, eye diseases, II, 114, 116, fatty liver, I, 302, indigestion, I, 269, 270, respiration exchanges, &c., I, 422, 423, 437–440, skin absorption, II, 129
Gaskin conformation, I, 22, 23, 80, 86.
Gasserian ganglion of cranial nerves, I, 393.
Gastric artery formation, I, 452.
Gastric digestion and juice composition, uses, and action of juice, I, 235, 244, II, 405, drugs affecting, II, 449, 455, 466, 467, gastric irritation and effects, I, 259, 273; peptic glands for secretion of, I, 234, 235, process of digestion, I, 244.
Gastric plexus—formation, I, 377.
Gastritis and its treatment, I, 273–275, abuse of drugs causing, I, 270; rupture due to, I, 277
Gastrocnemii tendons —sprain, II, 300
Gastrocnemius muscle—form, &c., II, 44, 52
Gates—to stable yard, III, 334
Geldings hernia rare in, I, 315, penis and sheath swellings, II, 82 (see also Castration.)
Gemelli muscle —form, &c., II, 54.
General examination as to soundness, III, 378, 379.
General symptoms of disease—definition, III, 114, diagnosis and examination for, III, 115–130
General warranty form of, III, 406.
Generation —alternate process and influences, III, 180–183, 185 (see also titles Evolution, Reproduction.
Generative or genital organs —see title Reproduction Organs
Genio-hyo-glossus muscle of tongue —form, &c., II, 314
Genio-hyoideus muscle form, &c., II, 313.
Gentian —medicinal uses, II, 464, 466, III, 4; doses, III, 10, 11.
Geology —horses of present and past, III, 471–484.
German boil form, &c., II, 159.
German horses description and types, I, 175, 179, 196–210, III, 530
Germ-cell impregnation, &c., III, 245, 246, 248, 266, 454, 474
Germinal vesicle and spot in ovum, III, 247, 248, 288.
Germs—air before and after respiration, I, 417, 488; antiseptic preparations and destruction of, II, 459, I, 481 (for causes of disease see titles Bacteria, Organisms, Parasites.)
Gestation —changes in uterus, and physiology of, III, 252, 264–275, 413
Giddiness —due to brain, I, 435, megrims or vertigo, I, 407–409, quinine uses, II, 451, worms causing, II, 171, 174
Gilbey, Sir W. early horse history, I, 172, 175, 177, horses owned by, I, 123, 185.
Gin for colic, I, 291.
Ginger medicinal uses, II, 447, 462, III, 4, doses, III, 10, 11.
Girth —position and measurements from, I, 16, 91, III, 297.
Glancer stallion 535 (Clydesdale breeding from, I, 169, 174)
Glanders and Farcy
Appearance of illust., II, I, 34
Causes, infection, incubation, and symptoms, II, 34–37, III, 151, 152, organism or bacteria causing, I, 223, 224, 451, II, 34, 160, 420.
Communicable to human subjects, II, 37.
Complications—anæmia, I, 479, bleeding nose and lungs, I, 503, II, 10, laryngitis, I, 307, nasal catarrh, I, 306
Designations and early history, II, 33, 34
Distinction, II, 37 from covering disease, II, 52, horse pox or pseudofarcy, II, 141, 142, stomatitis pustulosa, II, 46, 50
Examination for, III, 379, 371.
Form of blood poisoning, I, 491.
Mallein test and syringe, I, 226, II, 35–37, 38, 39.
Mercury uses, II, 472.
Sale of horses—restrictions, &c., III, 422.
Suppression—act, and measures, II, 37; III, 152.
Unsoundness and warranty, III, 422.
Glands—absorbent system, I, 479, drugs affecting glands, II, 464, 467, 472, III, 5, structure—eye, II, 105, 118, III, I, 17 intestines, I, 256, 258, pancreas, I, 241, reproduction organs, I, 17, II, 66, 67, 69, 70, 74, 82, skin, II, 126, 127–131, soundness examination, III, 372; symptoms of diseases, I, 500, II, 41, 50, 51, salivary glands (see that title).
Glans penis formation and swelling, II, 69, 70, 82.
Glass causing feet injuries, II, 360
Glass of the eye part like white of egg, II, 105.
Glauber's salt medicinal uses, II, 459.
Glaucoma and its treatment, II, 125.
Glenoid cavity, &c., of scapula, II, 104, 270
Gliding joints forms, &c., II, 263.
Globus major and minor of testis, II, 69, 70
Gloss-anthrax —symptoms, &c., II, 443, 444.
Glossitis and its treatment, I, 252, 253.
Glossopharyngeal nerve and connections, I, 382, 389, 393, 395
Glossy skin —clothing uses, III, 17, drugs used, II, 453, 474, 491, III, 4, use of vitriol, I, 247
Glottis of larynx, I, 415 — muscle action, II, 317.
Glue bandages uses, &c., III, 15
Gluteal artery formation, I, 452
Gluteal nerves formation, I, 401.
Gluteus muscles forms, &c., II, 339.
Glycerine medicinal uses, II, 444, III, 4.
Glycerine of carbolic acid —use as, &c., II, 444
Glycogen in digestion and muscles, &c., I, 241, 490
Glyptodonts animals to rival in, 507, 508.
"Godolphin Arabian" history and descendants, I, 111, 113, III, 547, 550.
Good stable plan, &c., III, 333
Goose-grease uses, III, 15.
Goose-rump —condition causing, I, 60, 151, 160
Goubaux and Barrier on conformation and defects, I, 59, 80, 85, 89, 92, 68, 71, 76, 99, 83, 91, 100, compensating points, I, 101, centre of gravity and equilibrium, I, 80, coupling of head and neck, I, 45, defective action, II, 396, height, length, and weight, I, 91, 92, 95, 96, 97, 99.

Goulard's extract—as a lotion, ii, 464
Gout—heredity influence, ii, 20; see also Arthritis.
Gowing's parturition instrument, iii, 283
Graafian follicles of ovary, ii, 78, 79, 80, 111, 184, 246–248, dilatation, ii, 102.
Gracilis muscle—form, &c., ii, 341.
Grain as food—choice, mixture, &c., iii, 107, 108, 344–347, for show horses, iii, 311; bulking, iii, 28, disease due to, iii, 102. See also titles Corn, Oats, Wheat &c.
Grains of Paradise medicinal uses, ii, 462.
Granolithic paving for stables, iii, 327
Granulation ulcers covered with, ii, 426, 427; wound healing and drugs used, ii, 405, 407, 412, 413, 457, 493; tissue in stone of bladder, i, 358.
Grass (see title Pasture and Grass
Grass-woven shoes—uses, iii, 429.
Gravel—(see Stone)
Gravity—see Centre of gravity.
Gray powder—medicinal uses, ii, 488.
Gray substance of brain and spine, i, 381, 383, 394, 387
Grazing (see Pasture).
Grease disease—causes, &c., ii, 127, 140, 141, iii, 68, 340; drugs, &c., ii, 448, 450, 464, 474, 485, iii, 7; horsepox distinction, ii, 43, 140, 141; mange mite in, ii, 107, similarity of canker, ii, 381; unsoundness and warranty, iii, 374, 381, 422.
Great anterior cranial nerve—formation, i, 393
Great crural nerve formation, i, 402
Great horse—origin and history, i, 173–176, 179, 180, iii, 539, 540, 543.
Great hyo-glossus muscle—form, &c., ii, 334
Great metatarsal artery—formation, i, 453
Great portal vein—circulation through, i, 447
Great splanchnic nerve—form, i, 376, 377
Grecian horses history, &c., iii, 520, 521, 52
Green food—composition and advantages, use of silage, &c., i, 243, 244, iii, 80, 115–118, 351, digestibility, iii, 90, 91, 97, 99, invalid diet, iii, 26, for various diseases, i, 273, 285, ii, 23, 24. See also title Pasture and Grass.
Green paints causing poisoning, iii, 49
Green scum on water causes, iii, 129
Gregarines—form of parasite, ii, 161.
Grinders—structure of teeth, i, 63; inflammation due to, i, 252.
Grinding of food—teeth and muscles acting in, i, 251, ii, 310
Gripes causes and treatment, i, 278–281; flatulent colic, i, 281–284, drugs for, iii, i, 42; enteritis mistaken for, i, 293; unsoundness and warranty, iii, 423.
Gristle—structure of bone, foot, &c., ii, 178, 197, 202, 370, iii, 437.
Grogginess a form of unsound foot, iii, 422.
Groins—structure and swelling, i, 17; ii, 22, 144; examination for soundness, iii, 373
Grooming—appliances and methods, iii, 134–137, 139, 360, horses in training, iii, 303; sick horses, iii, 143, tramway horses, iii, 318, trotters, iii, 316.
Grooms—qualifications and management, iii, 333, 349
Grooves in shoes—uses, &c., iii, 443, 445.
Grooves in teeth—age evidence, iii, 401, 402.
Ground surface of shoes, iii, 443.
Growth of the horse development of present and past types, &c., iii, 471–484, 517–520; evolution and other influences, iii, 286–288, 298, late before birth, iii, 282–295; rate after birth, iii, 294–296.
Growths bone diseases, ii, 205, 206; cornea of eye, ii, 118; drugs destroying, &c., ii, 453, 468, 482, iii, 2, 4, 6, 7, 11; gut-thickening causing obstruction, i, 296; heart valves and aorta disease, i, 464, 472, 473; loose cartilages around joints, ii, 284, 285, Keratoma, or horn tumour, ii, 372; larynx growths, i, 507, 512, operations for destruction, iii, 166, 167, ovarian cysts, ii, 103; penis and sheath, ii, 81, 82, 83, sterility causes, iii, 226, various diseases due to, i, 276, 277, 350, 351, 353, ii, 14. (See also titles Cancer, Cysts, Tumours.)
Gruel—preparation, iii, 27, for hunters, iii, 113, 309, mares, iii, 227, 270; sick horses, iii, 141.
Grunting—a test of roaring, i, 511.
Guarantee as to soundness—see titles Examination, Warranty.
Guard bit—type and use, iii, 359.
Guinea-pigs inoculation for various diseases, iii, 37, 38, 42, 45.
Gullet—obstruction, i, 265.
Gullies for stable drainage, iii, 85, 86.
Gum acacia medicinal uses, iii, 5, 11
Gum-arabic as an antidote, iii, 54, 60.
Gums—astringents for soft gums, ii, 457, blueness due to poison, iii, 51, inflamed, due to teeth, i, 326, 330, spots on, i, 240; wound due to bone disease, ii, 213.
Gustatory nerve formation, i, 394
Gut—colic effects on, i, 278, 295; hernia or rupture treatment, i, 317, 319–323, inversion of rectum, i, 301, 302, obstruction due to thickening or twisting, i, 296, operation uses, iii, 163, 164, 175, 185. See also Cat-gut
Gutta percha—for fracture uses, ii, 241, for tooth filling, i, 331
Gutters for stable drainage, iii, 84, 86, 329.
Guttural pouches form, and diseases due to pus in, i, 504–507, 511, iii, 508

H

Habits, bad—see Vices.
Hackney Horses
Action—points and importance, i, 121–123.
Appearance and conformation, i, 116, 118–121.
Breeding and crosses, i, 114, 115; Arab cross, i, 203, Cleveland Bay, i, 130, 131; Oldenburghs and Holsteins, i, 208, 209, pack horse resemblance, i, 1–5.
Early uses and origin, i, 113–118.
Harness horse qualifications, &c., i, 152, 153.
Height and speed—trotting pace, &c., i, 116–118
Illustrations—mare, i, 306, stallions, i, 38, 172, 180, teeth, iii, 396.
Hackney pony—appearance and origin, i, 170; breeding uses, i, 160, 161, 162, 171.
Hacks—conformation, &c., i, 147–149, Arabs as lady's hack, i, 203, show horses, iii, 310, 312.
Hæmatemesis a form of bleeding, i, 501.
Hæmatinics—medicines termed, ii, 447.
Hæmatograph showing pulse waves, iii, 148.
Hæmatopinus on skin, ii, 166
Hæmaturia and its treatment, i, 347, 348
Hæmoglobin—in blood, i, 432, 433; air-changes, i, 480, in urine, i, 344.
Hæmo-globinuria and its treatment, &c., i, 343, ii, 29–31, analysis of urine, &c., ii, 26–29, fracture symptoms mistaken for, ii, 237.
Hæmophilia and its treatment, i, 501, ii, 158, 159.
Hæmoptysis—description and treatment, i, 501; ii, 19
Hæmorrhage see Bleeding
Hæmorrhagic diathesis and its treatment, ii, 156, 159.
Hail—Arab stud at, i, 202, 204, 205
Hair—composition and growth, ii, 125, 126, 131, 132, iii, 405, 504, 505, on ear, i, 12, groin, i, 17, lip, i, 5, nostrils, i, 9; eggs of bot fly on, ii, 170, loss—dietetic treatment, ii, 141, mange, ii, 106–168, nettle rash, ii, 149, ringworm, ii, 164, 170, senile decay, ii, 155; removal for wounds and blistering, &c., i, 472, iii, 48, 80, washing in disease, iii, 45. See also titles Coat, Feather, Staring coat
Hair follicles—structure and secretions, ii, 125, 126, 131
Hairy growths on eye, ii, 118.
Half-man half-horse—fable on origin of, iii, 521.
Halt-and-go-lame due to "speedy cut", ii, 401.
Halters—for stalls, iii, 328; operations, iii, 157, training trotters, iii, 314
Hampton Court stud—foundation, i, 110.
Hamstrings—conformation, i, 23, 86; sprain and thoroughpin effects, ii, 300, 357.
Hand-gallop—form of, iii, 196, 197
Hand-rearing of foals, i, 287, iii, 222–224
Hands—cleansing for operations, &c., ii, 421, 484, 4, 7, 488, iii, 4, 154, 182, 185; driving influences, iii, 312, structure compared with foot of horse, iii, 491, 501–504, 508.
Hanoverian horses—origin, appearance, &c., i, 206, 207, 209, illust. of, i, 320.
Hard ground causing disease, ii, 207, 219, 220.
Hard liver—cause of, i, 307
Hard-mouths—production causing lip troubles, i, 248.
Hard palate—structure, i, 7
Hard water—analysis, disease cause, and softening, iii, 122–124, 131.
Hard work too early, effects, ii, 348, 349; training for, iii, 302.
Harness—accidents and liability, iii, 418; adjustment, choice, and care, iii, 357–359; friction causing disease, ii, 144, 145, 433, 435, infection from, ii, 150, 151; iii, 152, putting on a cause of diarrhœa, i, 287, show horses, iii, 313; undoing on falling horses, ii, 441 training trotters, &c., iii, 314.
Harness Horses—
Breeding and crosses, i, 152, 153, iii, 290; comparison of British and foreign breeds, i, 208, 209
Breeds suitable—Cleveland bays, i, 125, 126, 129, 131, 133, hackneys, i, 122; Morgans, i, 207, Yorkshire coach-horse, i, 133.
Conformation, action, and training, i, 149–152, ii, 320, iii, 310–314.
Diseases common to—brain tumours, i, 415; due to occupation, i, 219, sore shoulders, ii, 435.
Illustration of type, i, 222.
Shoes suitable, iii, 443, 445.
Harness pony—use of type, i, 160.
Harness room—structure, &c., iii, 331–333, 337; plans, iii, 320–324
"Harold"—Shire stallion illust., i, 98.
Harold strain—breeding prepotency, iii, 212.

Haunch and bones—conformation, &c., i, 15, 98; muscle connections, ii, 325, 336, 339, 340; joint position and fracture, i, 15; ii, 222, 223; "sinking of" causes, &c., i, 15; sitting on due to rupture, i, 295, 310.

Haversian canals in bones, ii, 176, 177.

Haw of eye—structure and examination, i, 11, 12; ii, 103, 104, 109, 110; iii, 357, 358.

Hay—
As food—amount, composition, kinds, i, 241, 243; iii, 89, 93, 97, 98, 99, 110–112, 340, 351–354; digestion of, i, 246, 247; iii, 90, 91, 96, 97, 99, 118; heat and force influences, iii, 100, 101, horses in training, iii, 303, 304; oats and long hay as side diet, iii, 343, 346; special diet for broken-wind, ii, 13.
Bedding uses, iii, 355.
Chewing, and choking due to, i, 233, 266.
Diseases due to bad hay, i, 221, 273, 346; ii, 42; iii, 102, 104; poisoning, iii, 92.
Organisms in hay, i, 224, 225, 228.

Hay bacillus—discoveries, &c., i, 224, 225, 228.

Hay-lofts—structure, &c., in, 320, 322, 323, 326, 331.

Hay-racks—stable fittings, in, 327

Hay tea—preparation, in, 27.

Hayes, Capt.—on conformation, i, 42, 43, 55, 57, 62, 63, 65, 70, 77; on bone disease, ii, 214

Head—
As a unit of measurement for body proportions, i, 99–101
Birth presentations, iii, 274, 279–282.
Carriage and position, i, 46, of show and harness horses, iii, 312, 313; diseases influenced by, i, 470, 502; influence on weight of body distribution, i, 91, 92.
Conformation, i, 2, 3, 4; compensating points for defects, i, 102; divisions—extremities of head, i, 4–8; surfaces and soft parts, i, 8–12; forms of heads and various views, i, 4, 6, 36, 37, 38–42; general aspect and volume of head, i, 37, 38; length proportions, i, 43; nerves, glands, veins, and arteries, i, 402, 449; muscles, ii, 307–310, 318–320; special features, in, 402–405.
Connection or coupling to neck, &c., i, 44–46; ii, 204, 205, 207–209; bones supporting head, ii, 180, 181; muscle connections, ii, 318–320.
Examination as to soundness, in, 370–372.
Growth—rate, in, 207
Joints or articulations, ii, 205, 270.
Poulticing, in, 30, 32.
Spasm due to tetanus, ii, 47, 48.
Striking—a cause of poll evil, ii, 430.
Swelling due to horse sickness, ii, 55, 56
[For special parts see titles Brain, Cranium, Ears, Nose, Skull, &c.]

Headache—horses suffering from, ii, 478

Head-stall for horse-training, iii, 307

Head to tail attachment in operations, iii, 157

Healing of wounds—natural processes, ii, 404–407, 412

Health—definition, degrees, and hygienic principles, i, 213; in, 64, 65, 66–69

Hearing—bones connected with, ii, 184, 185, nerves, i, 385, 391, 395; muscles and cartilages, ii, 311 (see also Ears)

Heart—
Absorbent system influence, i, 429.
Anatomy, action, and functions, i, 436–441, 456; in embryo, iii, 251, 252, 253; nerves and arteries, i, 440–444, 448; ii, 455; pulse feeling and kinds, in, 146–148; systolic action and other sounds, &c., i, 439, 443, 460—diagram, iii, 148, sound due to poisoning, iii, 57.
Drugs and examination see Heart diseases

Heart Diseases, &c
Classification, and indifference shown by veterinarians, i, 454, 460, 491.
Considerations on pathology and general symptoms of, i, 471–488.
Drugs affecting heart, ii, 452, 457; as stimulants, ii, 455–460, as tonics and sedatives, ii, 460–462, iii, 4.
Enlargement, atrophy, and rupture, i, 465–467, 479
Examination of heart—general remarks, i, 454–458, difficulties and methods, i, 458–461
Fatty degeneration and infiltration, i, 467–479
Inflammation of heart sac pericarditis, i, 461–463, of lining membrane endocarditis, i, 463, 464, of muscular structure (myocarditis), i, 464.
Pulse—feeling and kinds, in, 146–148.
Valvular diseases, i, 464, 465; liver affected by, i, 303.
Various diseases affecting heart, or resulting from heart disease—blood-poisoning, i, 482; circulation deranged, i, 456, 457, 458, dropsy, &c., i, 310, 311, 312, 457; filled legs, ii, 394, 395, joints affected, ii, 280; lungs congested and bleeding, ii, 5, 10, rheumatism, ii, 21, spasm of diaphragm, i, 312.

Heat as cause of disease, i, 216, 219, 222; food influences, iii, 85, 99, 100; giddiness and inflammation due to, i, 497, in, 130; nerve controlling, i, 389, respiratory process effect, i, 490; stimulation of heart, &c., ii, 459; ventilation uses, iii, 74, 76, 80, 81; water purification, iii, 121

Heat, period of—(see Œstrum).

Heating apparatus for stables, &c., iii, 320, 325, 332, 333, 334

Heavy horses—classification, i, 172 (See also title Draught or Cart Horses, special breed, see Clydesdales, Shires, &c.)

"Hedon Squire"—show success of, i, 123.

Heels—cracked, ii, 423–425, other causes, &c., ii, 99, 144, 145, defective action injuries, ii, 308, 309, fracture symptoms, ii, 253; poulticing, iii, 31; shoeing preparations and injuries, iii, 440, 445, 447, 448, 457, soundness examination, iii, 371; spasm, ii, 294, 295, ulcers, ii, 426 see also Grease

Heels of shoes—forms, iii, 444.

Height of a Horse
Conformation and measurements, i, 93–95; body and limbs, i, 96, 97, chest, i, 64, 65; elevation at croup, i, 93, 94, at withers, i, 13, 52, 93, 94 proportions to length, i, 99.
Increase, &c., due to climate, i, 201, 202; iii, 540, 541, 542, 545, 546, 547
Ponies difficulties and measurements, i, 94, 154, 155, 157, various breeds, i, 194, 195–199, 170, 171.
Rate of growth, iii, 267, 271, 274–276
Roaring influenced by, i, 511.
Various breeds—Arabs, i, 201, 202; Clydesdales, i, 192, hackneys, i, 119, heavy horses increase, i, 180; Holsteins, i, 209; hunters, i, 139, Morgans, i, 207; Percherons, i, 206; Scottish "large horse", i, 186, 187; Shires, i, 174, 175, 178, 181, 184, Suffolks, i, 194, 199; Yorkshire coach horse, i, 134

Helminths—forms and diseases due to worms, ii 102, 109, 120, 174–175

"Helmsley Turk"—history, i, 111; iii, 544.

Hemiplegia and its symptoms, &c., i, 420.

Hemlock medicinal uses, ii, 453; doses, iii, 10, 11.

Hemorrhage—see Bleeding.

Hemorrhages (or bleeding), ii, 150, 158

Hemp—see Indian hemp)

Henbane—medicinal uses, ii, 451; iii, 10, 11.

Henle, loop of—formation, &c., i, 334, 335.

Henry VII and VIII—horse breeding, &c., i, 173, 175, 179, 180, 541, 542.

Hepatic artery and vein—forms, i, 447, 452, liver structure, i, 299, 300

Hepatic plexus—formation, i, 377

Hepatic tissues analysis for disease, &c., ii, 27, 28, in health, ii, 26.

Hepatitis and its treatment, i, 305, 306

Hereditary Diseases and **Influences**—
Breeding precautions and transmission, in, 215, 240, 249, 287, rate of growth, iii, 286, 287; colour and markings, iii, 500.
Causes of disease, i, 214, 217.
Diseases—bleeding from nose, i, 503, bog-spavin, ii, 290, bone-spavin, ii, 217; broken wind, ii, 12, brittle hoof, ii, 383, curb, ii, 300, 302, crib-biting and nervous habits, i, 413; epilepsy, i, 411, eye affections, ii, 116, 121, filled legs, ii, 394, hernia, i, 313; laminitis, ii, 280, malleniers, &c., ii, 158, navicular disease, ii, 290, rheumatism and gout, ii, 20; roaring and whistling, i, 510, shelly feet, ii, 368, side bones, ii, 367, 368, skin affections, ii, 139, 140, 153, 155, 159; sore shins, ii, 219; splints, ii, 207; windgalls and thoroughpin, ii, 356, 357.
Evolution modification, iii, 474.

"Hermit"—pedigree, i, 110 growth measurements, iii, 292, 293, rearing and hereditary influences, i, 112, 503.

Hernia—definition, i, 315. See also Rupture.)

Herniotomy for hernia, i, 321.

Herpes of the skin, ii, 149.

Herpetic ringworm—cause, &c., ii, 144.

Hiatus aorticus of diaphragm, i, 451; ii, 3 8.

High blowing and its treatment, ii, 19.

High in front—conformation, i, 95

High neurectomy—method, &c., in, 101–104.

High ring-bone—form of disease, ii, 208.

High stepping training, iii, 312.

Hilum of ovary, ii, 78, 79.

Hilus of kidney, i, 324, 326

Hind Limbs and Extremities
Action—in drawing a load, i, 62, 63; defective action and injuries, ii, 306–402.
Blistering, iii, 29.
Body-weight distribution, i, 91, 92.
Conformation and defects, i, 2, 3, 59, 60–62, 63–65, 90; bones, ii, 204–213; compensating points, i, 60, 102, nerves, arteries, and muscles, i, 395, 345, 402, 437; ii, 314, 315, iii, 401; special features, iii, 477, 490.
Diseases—see title Limbs—diseases.
Fractured bones, ii, 260–262, causing paralysis, i, 350, ii, 36, 37
Functions of the limbs, i, 67.
Growth before birth, iii, 256, 264, after birth, iii, 294, 295
Soundness—examination, iii, 362–365.

Hinge joints form, &c., ii, 262; iii, 401.

Hip and Hip-joint
Conformation and bones, i, 67, 85, ii, 182, 183, 204, 205, 743 iii, 477, hip girdle and "point of the hip", ii 142
Dislocation rare, ii, 343
Examination for soundness, iii, 372, 373
Fractures, ii, 250, 257, 258, 259, pelvis fracture effects, ii, 251
Ligaments and muscles, ii, 274, 275, 339–341, 342.

Hipparion – fossil remains and horse origin, iii, 509, 512, 513.
Hippidium – fossil remains and horse origin, iii, 513.
Hippodrome Grecian performances and origin, iii, 522, 523, 531.
Hippomanes formation of, iii, 251.
Hippuric acid in blood, i, 435, in urine, i, 446, 454.
Hired horses law of warranty, iii, 417, 418.
History of horse-shoeing, iii, 420–432.
History of the horse ancestors, past and present types and records, iii, 471–474, 509, 513, 514–520, horses of Asia and Africa, iii, 530–535, of Britain, iii, 535–539, of Greece, iii, 521–525, of Rome, iii, 525–530, position in animal world, iii, 471, Scotch history, i, 186, 187. (See also titles Arabs, Evolution, Thoroughbreds, etc.
Hobbles – for restraint in operations, iii, 159, 160, 166, 172, preventing kicking, iii, 341
Hobday's castration table and details, iii, 176–185
Hock and Hock-joints Tarsus —
Chestnuts growth, i, 197, ii, 133, iii, 478, 500–502
Conformation and bones, i, 23, 86–89, ii, 291, 292, 293–295, 277–279, iii, 487, compensating joints for defects, i, 103, ligaments and muscles, ii, 277–279, 343, 344, 345
Difficulty in diagnosis of disease, ii, 217, 218
Diseases, &c., affecting—arthritis, ii, 286, 287, bog-spavin, ii, 290, bone-spavin, ii, 216–217, capped hock, ii, 362–364, iii, 24, loose cartilages in, ii, 284, mallenders and sallanders, ii, 157, stringhalt, ii, 145, thoroughpin, ii, 357, 358, wind galls, ii, 355. See also titles Bowed knees and legs, Cow-hocks, Curb
Fractures and sprain, ii, 221, 261, 262, 300
Growth measurements from birth, iii, 201, 202
Poulticing and bandaging, iii, 32, 37.
Soundness and warranty, iii, 374, 383, 415, 418
Hollow back from age and natural conformation, i, 56, 57, 58, harness horse defect, i, 150.
Hollow of the eye, i, 8, 19.
Hollow of the flank, i, 17.
Holstein horse—appearance, &c., i, 200.
"Holyrood" Clydesdale stallion illust., ii, 1.
Hoof and Horn –
Conformation and growth, i, 227, ii, 160, 290, iii, 1, 2, 3, 4, 5, contracted, ii, 30–305, horn structure, ii, 151, 302, 303, iii, 4, 5, 134, 504, 505, 506, muscle in connection with, ii, 280, model and nerves of hoof, ii, 298, overgrowth of horn, iii, 4, 5, 4, 9, rings on hoofs, iii, 120
Cutting or rasping for quittor, ii, 370, for side bones, ii, 268, for sand crack, iii, 435.
Diseases causing brittleness, &c.—canker, ii, 372, coffin, ii, 375, indigestion, i, 275, ring-bone, ii, 295, 296, sand crack, ii, 305, 360, seedy toe, ii, 306–371, shelly feet, ii, 307, 308, thrush, ii, 373, villitis, ii, 375, 374, wounds, ii, 414, tumour, ii, 572
Evolution and five-toed ancestors (see Five-toed animals
Fracture, ii, 252, 253, causing separation of horn from skin, ii, 254
Healthy condition preservation, iii, 67, 129, 130, 149
Moss litter affecting, iii, 137, 156.
Origin of ungulate mammals formation, iii, 476, 477.
Hoof and Horn—*Cont.*
Poulticing the heel, iii, 31.
Shoeing preparations and injuries, iii, 438, 440, 441, 449–450, 454.
Shoghing due to unnerving, iii, 165, 166.
Soundness examination, iii, 378, 379, 386, 420.
Wearing and hardening—early practices, iii, 523, 524, 529
(See also titles Cleft, Feet, Frog.)
Hoof ointments—use of, iii, 130
Hoofed mammals classification and horse-origin, &c., iii, 475, 477, 510.
Hooks for various uses, iii, 134, 159, 253
Hopper windows for stables, iii, 25, 31
Hops—medicinal uses, ii, 466, 467, 474.
Horn as appendage to skin, ii, 125, 132, 133.
Horncastle Fair—warranties, iii, 413.
Horn of hoof—see Hoof.
Horn tumour of feet, ii, 572
Horny growths –origin, &c., iii, 478 (See also Chestnuts, Ergots.)
Horse balls—see Balls
Horse-chestnuts –poisonous quality, iii, 104
Horse-gag for giving physic balls, iii, 20
Horse-hair– growth, ii, 132, for wound-stitching, ii, 410 (See also Hair.)
Horse-hair crupper as means of restraint, iii, 156.
Horse-pox and its treatment, ii, 43, 142–142; appearance illust., ii, 42, American form, ii, 142, communication to man, ii, 43, lip troubles due to, i, 248 (See also Grease disease.
Horse-sickness—see title South African Horse-sickness.
Horse thane—ancient appointment, iii, 537
Horse-training—see Training.
Horsing—see Æstrum.
Host in parasitic diseases, ii, 160, 162.
Hot applications, fomentations, &c —effect on blood-vessels, and making of, i, 278, ii, 462, for bone and bog spavin, ii, 216, 291, capped elbow, &c., ii, 360, 361, 364, colic, i, 261, curb, ii, 302, eyes, ii, 115, fractured vertebræ, ii, 257, hemorrhage, i, 503, ii, 80, lymphangitis, ii, 23, intestinal obstruction, i, 297, inversion of rectum, bladder, uterus, i, 302, 372, ii, 101, kidneys internal fomentation, ii, 474 male reproduction organs, ii, 82, 87, pneumonia and pleurisy, ii, 10, 15, poll evil, ii, 341, rheumatism, ii, 21, ring-bone, ii, 296, skin poisoning, ii, 129, spasm of larynx, ii, 15, speedy cutting wounds, ii, 401, sprains, ii, 203, 204, 205, 354. See also titles Blistering, Firing, Inhalation.
Hot fitting in shoeing, iii, 441
Hot-water heating apparatus for stables, iii, 76.
Human ovum—formation and development influences, &c., iii, 251, 252, 258, 420–424
Human subjects horse diseases communicable to, ii, 37, ii, 154
Humeral artery and branches, i, 440
Humeralis externus muscle—form, &c., ii, 270
Humero-radial joint—form, &c., ii, 270
Humerus bone—conformation, i, 71, ii, 104, 105, dislocation, ii, 350, fracture, and setting difficulty, ii, 220, 244, muscles connected with, ii, 326, 330, 333, sprain due to disease of bone, ii, 293.
Humours of the eye description and disease, ii, 136, 137, 165, 124
Hungry horses– diet restrictions, &c., i, 269
Huns–**horses of**, description of breed, iii, 520.
Hunters and Hunting
Accidents, &c. first aid, ii, 437, 438, 440; treatment of "pumped-out" animals, ii, 9; iii, 399
Action, jumping, and training, i, 146; iii, 199–202, 305–310, show horses, iii, 309–312, staying powers, i, 140, 141, 144.
Breeding and crosses Arab uses, i, 141, 202, Cleveland bay, i, 131; Irish breed excellence, i, 137, 138; pack-horse cross, i, 125, thoroughbred cross and uses, i, 125, 135, 137, 138, 139, 141, 143, cistern breed, production difficulty, i, 125, 140, 143, 144; king's premiums distribution, i, 140, 141.
"Condition"—use of term, ii, 443.
Condition or physic ball for, ii, 446.
Conformation—early types, i, 137–139; modern types, i, 144–147, of canon, i, 76, forearm, i, 73, head, i, 37, shoulder, i, 70, thigh, i, 75.
Diseases, &c., common to, i, 204, bleeding nose, i, 503, bowed knees, ii, 308; congestion of lungs, ii, 5, 6, curb, ii, 300, 302; diarrhœa, iii, 191, filled legs, ii, 364, navicular disease, ii, 301; pleurisy and tetanus due to swimming, ii, 14, 45, skin and mud fever, ii, 139, 144, iii, 135–137, spasm of diaphragm, i, 311, thrombosis, i, 474
Food and pasturage, iii, 95, 113, 114, 309, 310, 347
Fractures common to, ii, 227, 235, 236, 249, 250, 256
Grooming and care of feet, iii, 135, 136, 149
Illustrations of hunters, i, 214; ii, 450.
Origin and early history, iii, 523, 531, 538, 540, 545, 547
Pony breeds suitable, i, 165, 166, 173.
Railway boxes infection and washing, iii, 153.
Shoes and shoeing, iii, 414, 444, 446, 447, 457.
Sprains common to, ii, 204, 205.
Stable plans and harness room, iii, 320, 332, 333.
Husk a form of bronchitis, iii, 140
Hyaloid membrane of eye, ii, 108.
Hybrid horse-breeding, iii, 230, 241
Hydatids—infesting brain, ii, 163, 163, 174, 175, liver, i, 285, 287, ii, 174; alternate generation, iii, 201
Hydrated oxide of iron as antidote to poisoning, ii, 447, dose for peroxide of iron, iii, 15
Hydrocele inducements, ii, 140, unsoundness, iii, 57.
Hydrochlorate of morphine dose, iii, 10.
Hydrochloric acid—digestive uses and production, i, 235, 243, ii, 404, 465, 467, iii, 55; doses, iii, 62; poisoning by, iii, 46, 47
Hydrocyanic acid—dose, iii, 9.
Hydrophobia indications, ii, 44.
Hydrops-pericardii—a form of heart disease, i, 454
Hygiene see Veterinary hygiene
Hymen of reproductive organs, ii, 74, 75.
Hyo-epiglottideus muscle form, &c., ii, 310.
Hyo-glossus muscles of tongue—forms of, ii, 306, 314, 315
Hyo-pharyngeus muscle—form, &c., ii, 315.
Hyoid bone – see Tongue
Hyoid process of temporal bone, ii, 185.
Hyoid region – muscles, ii, 312–314, 321.
Hyoidal articulations—form, &c., ii, 266.

Hyoideus transversus muscle—form, &c, ii, 313.
Hyoscyamus for lungs, ii, 470, 471.
Hyoscyamus—medicinal uses, ii, 474, 481.
Hypertrophies—skin diseases, ii, 154, 155
Hypertrophy of heart, i, 465-467.
Hypnotics—medicinal uses, ii, 476, 477, iii, 14.
Hypochondriac portions of abdominal cavity, ii, 339.
Hypodermic syringe for injections—use, iii, 21.
Hypogastric portion of abdominal cavity, ii, 338.
Hypoglossal nerve—description, i, 376, 386, 397.
Hyposulphites—medicinal uses of soda, ii, 449, 450, sulphur, ii, 490.
Hyracotherium—fossil remains, iii, 510, 511, 512
Hysteria—hæmo-globinuria termed, ii, 20

I

Ice—for brain disorders, i, 271 for hemorrhage of nose and lungs, i, 564, ii, 10.
Ichthyosis and its causes, &c., ii, 153, 154; heredity influence, ii, 139, 140.
Icterus and its treatment, i, 304.
Idiopathic pericarditis—form, i, 462.
Idiopathic symptoms of disease, iii, 144.
Idiopathic tetanus—form, ii, 45, 46
Ileo-cæcal valve of intestine, i, 237.
Iliac arteries—form, i, 452; disease, i, 474, 475; ii, 237.
Iliac portions of abdominal cavity, ii, 338.
Iliac thrombosis—cause, symptoms, &c., i, 474.
Iliaco-muscular nerve branches—formation, i, 392.
Iliacus muscle form, &c., ii, 325.
Ilio-femoral artery formation, i, 452
Ilio-lumbar artery—formation, i, 452.
Ilium—formation, &c., i, 153; ii, 192; fracture, ii, 221, 259-259; muscles insertion, ii, 325, 336. See also Haunch
Illness, sudden—directions, ii, 437-441
Immediate union method of wound-dealing, ii, 404
Immovable joints—form, &c., ii, 263, 279.
Impacted fracture—form and treatment, ii, 221, 225, 226.
Impetigo—drugs for, iii, 1, 8.
Impregnation—process, and changes in ovum due to, iii, 240-243, 261-264; telegony and hybrids, iii, 239, 240.
Impregnation-tube—use of, iii, 263.
Impressions and impulses due to nervous system, &c., i, 373, 374, 379, 382, 386, 387, 388, 389; paralysis effect, i, 420
Inbreeding—ponies success, i, 156, 161, thoroughbreds, i, 169.
Incised wounds—their treatment, ii, 402, 410-412.
Incisor teeth—form, growth, &c., i, 6, 30, 327, iii, 384, 390-392, 396-399, 401, temporary teeth, iii, 393-395, wear and grooves in, iii, 399-402; fracture and other effects, i, 330, 332; ii, 242, 243.
Incubation in infectious diseases, ii, 25; iii, 130.
India—Arab uses in, i, 203, parasite infesting horses, ii, 174.
Indian hemp medicinal uses, ii, 482; iii, 5, 10, 11; poisoning by, iii, 54.
Indian pea—poisoning by, iii, 58-60.
Indian pease as food, iii, 350.
Indian vetches as food danger of, iii, 350.
Indigestion—acute or "staggers", i, 268-271, 400; chronic form, i, 271-273; drugs, ii, 448, 449, 459, 465, 466, 467, 472, iii, 2, 3, 4, 5, abuse of drugs, i, 272, food and errors causing, i, 272, iii, 102, 168, 169, saliva secretion due to, i, 251, 259, various diseases associated with, i, 273, 311, 340, 457; ii, 140, signs of disease, iii, 149; water effects, iii, 125.
Individual hygiene definition of term, iii, 133, 134, processes of grooming, &c., iii, 134-149
Indolent ulcers and their treatment, ii, 426, 427, drugs for, ii, 448, 459, iii, 7.
Indolent wounds—drugs, iii, 4.
Infectious Diseases—
Classification, causes, and list, i, 210, 224; iii, 133, 151, 152; special characteristics and recognition, iii, 150-152
Medicines for maintenance of strength, iii, 150, 151
Prevention and suppression—general care, iii, 149, 152, 153, railway boxes, iii, 153, 466; stamping-out by slaughter and isolation, iii, 149, 153-156; washing, disinfection, and occupation of premises afterwards, &c., iii, 24, 153-156.
Telegony—mare affected by first sire, iii, 240
Various diseases which are infectious, i, 424, 425, 494, 421, 497, ii, 32, 35, 287; iii, 267, 269
Warranty laws and sale of horses, iii, 422, 423
[See also titles Contagious Diseases, Fevers, Inoculation; for special disease see its name.]
Infective ulcers form, &c., ii, 427.
Inferior cervical ganglion—structure, &c., i, 379.
Inferior extremity of head—structure, i, 5, 10
Inferior laryngeal nerves formation, i, 391
Inferior lumbar region muscles, ii, 324-326.
Inferior maxillary bone—form, ii, 178
Inferior maxillary joint—form, ii, 185
Inferior maxillary nerve—form, i, 403.
Inferior region of body—structure, i, 16.
Inferior sesamoid ligament—form, ii, 278.
Inflammation and its causes, &c., i, 215, 2... arteries and veins, i, 471, bladder, i, 492; bone disease, ii, 206-212, bowels, i, 202-204, brain and spine, i, 405-407, 418, cracked heels, ii, 424, 425; eyes, ii, 31, 111, 114-117, 121; female organs of reproduction—uterus or womb, ii, 89-91, 97, 98, vaginal passage, ii, 91, 92, udder, ii, 93-97; lining, iii, 166, 167; glands lymphatic, ii, 36, parotid, i, 259-261; heart forms, i, 460, 461-464; hernia, i, 329, 334, 335; joints and sprains, ii, 280, 281, 282-284, 297; kidneys, i, 348; lips and mouth, i, 248, 249-252; liver, i, 295-308; lungs and complications, ii, 5, 7-10, 14, 402; iii, 142; male organs of reproduction, ii, 82, 86; paralysis due to, i, 420; skin diseases see that title, teeth, i, 330; temperaments liable to inflammation, i, 218; temperature as cause, iii, 136; tongue and throat, i, 252, 254-257, 507; unsoundness and warranty, iii, 423; wounds, ii, 408.
Influenza—causes, treatment, &c., i, 223; ii, 31-33; iii, 144, 152, contagious pneumonia a form of, ii, 7, 33, drugs, ii, 451, 467, 472; iii, 3, 4, 6, 7, joints affected by, ii, 270, 282, 286; "pink eye", ii, 31.
Various complications anæmia, i, 470; bladder, i, 520, bronchitis, ii, 2, eyes, ii, 115, filled legs, ii, 274, glanders, ii, 36; heart, i, 461, liver, i, 303; lungs, ii, 5, œdema of blood plexus, i, 416; parotid glands, i, 259, pleurisy, ii, 14, pneumonia, ii, 7, 8, purpura hæmorrhagica, ii, 24, pustulations, i, 504, 506, roaring, i, 513, 514, rheumatism, ii, 20, shelly feet, ii, 305; skin purpura, ii, 145, sore throat, &c., i, 225, 507, wind galls, ii, 350
In-foal mares—[See Parturition and Pregnancy, Mares
Infra-orbital nerve—formation, i, 393
Infraspinatus muscle form, &c., ii, 328.
Infundibulum on teeth, iii, 395
Infusoria—forms and diseases due to, i, 240, ii, 101, 169; generation, iii, 259; water purification, iii, 127.
Inguinal canal—structure, i, 17, ii, 63; castration effects, &c., iii, 156-122.
Inguinal hernia—bubonocele form, i, 318, strangulated, i, 319-322
Inhalation and fumigation—for bronchitis and asthma, ii, ... catarrh, i, 508, 501, laryngitis and spasm of larynx, i, 509, ii, 12, parotid glands, i, 260; strangles, ii, 49, 41, throat abscess, i, 255, drugs and antiseptics used, ii, 472, 475, 477, 491, iii, 13; horse-sickness due to inhalation, ii, 54, 55; premises and infectious diseases, iii, 155.
Inhibitory nerves of heart, i, 441
Injections and Enemas
Administration, and medicines given by, iii, 18, 21, 22.
Antiseptics and drugs used, ii, 434, 436, 459, 460, 480, iii, 1, 6, 8
Bacteria experiments causes of disease, i, 227.
Bladder-washing after stone, and for stone solvents, i, 491, 505, 506, 507, 508.
Foals at birth, iii, 223, 224.
Glanders—mallein test, ii, 35, 37, 38, 39.
Guttural pouches removal of pus, i, 506.
Horse-sickness, ii, 55, 56.
Intestinal troubles and treatment—colic, i, 250, constipation, i, 271, 275, enteritis, i, 204, obstruction, i, 207; ovaries, iii, 111, parturient fever, ii, 99, uterine hemorrhage, ii, 89—holding tail down to retain, ii, 474.
Nasal injections for catarrh, &c., i, 505, 504.
Pneumonia—injections into lungs, ii, 33.
[For skin injections, &c., see also titles Intra-tracheal, Intra-venous, Subcutaneous Injections.]
Injuries—accidents and attitudes useful in, ii, 437-441; bone diseases due to, ii, 209, 210, defective action see that title; eye injuries, ii, 111, 112, 114, 121, foals at birth, iii, 227, fracture and dislocation causes, ii, 214, 219, joint diseases, ii, 270, 281, 282, 286; nervous system—effect and protection from, i, 370, 390, shoeing results, iii, 452-458.
In-knees—defect, i, 74, 75.
Inoculation in infectious diseases, iii, 150-152; anthrax, ii, 42, 43, contagious pneumonia, ii, ... glanders and farcy, ii, 37, 38, 39, horse pox and small pox, ii, 4..., horse-sickness, ii, 54, 55, 57; stomatitis pustulosa, ii, 49, strangles, ii, 40, tetanus, ii, 45, 47, tuberculosis, ii, 81

Insalivation of food—digestive process, i, 233, 244; teeth influence, i, 326.

Insects—causing disease, iii, 78; horse-sickness, ii, 55, 56; poisoning of wounds, &c., ii, 403, 414; iii, 61; skin diseases, ii, 142, 163; stings, and drugs soothing, i, 249, 250, 252, ii, 81, 82, 414, 415; iii, 7, 61.

Insemination artificial process, iii, 231–234

Inseminator use, &c., iii, 231–234.

Insensitive laminæ of foot, iii, 434.

Insipidus diabetes and its treatment, i, 346.

Inspection of horses—see Examination.

Inspiration of breathing, i, 402, 403; asthma condition, ii, 11; muscles assisting in, ii, 322, 334, 335, 338.

Instruments and appliances—antiseptics and cleansing of, ii, 415, 484, 486; iii, 102; ball administration, iii, 20, 21; bandage roller, iii, 30; bloodletting results, i, 475, 476; foaling aids, iii, 282–284; firing, iii, 166, 167; grooming and clipping, iii, 134, 135, 137, 138; hernia trusses, &c., i, 317, 318, 321, 322, 325; neurotomy or unnerving, iii, 103, 104, 165; operation restraints, iii, 156–160; ovaries removal, iii, 181, 182; sand-crack clamps, ii, 367; stone in bladder, i, 362–364, 368–368; tenotomy, iii, 168–170; tooth rasps and shears, i, 329. (See also Castration, for special instrument see its name, as Catheter, Trocha, &c.

Insufflator for nasal catarrh, i, 500.

Integument—(see Skin).

Intelligence—head formation and nervous influences, i, 39, 374.

Interarticular fibro-cartilages of stifle joint, ii, 270.

Intercepting tank in stable drainage, iii, 3, 9.

Inter-condyloid fossa of thigh bone, ii, 261.

Intercostal arteries formation and hemorrhage, i, 452; ii, 253.

Intercostal muscles formation and uses, i, 63, 65, 402; ii, 334.

Intercostal nerves from spine, i, 381.

Interfering—forms of defective action, ii, 396–402; injuries and shoes, iii, 455.

Interlobular veins of liver, i, 240.

Intermaxillary space of head, i, 12.

Internal carotid artery—formation, i, 451.

Internal flexor of the metacarpus—form, &c., ii, 330.

Internal iliac artery formation, i, 452.

Internal intercostal muscles—form, &c., ii, 334.

Internal ligaments of hock-joint, ii, 278.

Internal maleolus of tibia, ii, 278.

Internal oblique muscle of abdomen, ii, 335, 336.

Internal organs unsoundness and warranty, iii, 423.

Internal popliteal nerve formation, i, 393, 404.

Internal pterygoid muscle and nerve formation, i, 384.

Internal respiration—form of, i, 483.

Internal saphenous nerve—formation, i, 404.

Internal tuberosity of humerus, ii, 194.

Inter-osseous arteries formation, i, 450.

Inter-osseous ligaments of knee-joint, ii, 272.

Inter-phalangial articulations—forms, &c., ii, 273.

Interrupted sutures for wound-stitching, ii, 416.

Intersesamoid ligament of fetlock-joint, ii, 272.

Inter-spinous ligaments—trunk connections, ii, 203, 265.

Intertransversales colli muscles—forms, &c., ii, 319.

Intertransverse muscles of loins—forms, &c., ii, 326.

Intervertebral articulations of the trunk, ii, 203.

Intervertebral foramina of spinal column, ii, 180.

Intestines—

Description and digestion process in, &c., i, 235–238, 245–247, 272; flow of bile, i, 240; foals at birth, iii, 220; lacteal system villi, i, 427; muscle structure, ii, 306; nerves, i, 236.

Diseases and disorders—calculi or stones, i, 298–300; cough, ii, 18, 19; debility, i, 296, 297; foreign bodies, i, 279; inflammation, i, 292–294; inversion of rectum, i, 301; obstruction, i, 296–298, 300; paresis of bowel, i, 296; pasture causing distension, iii, 65; poisoning and post-mortem appearances, iii, 45, 46, 47, 48, 54; rupture, i, 295; tuberculosis, ii, 51; ulceration, i, 296, 306.

Drugs affecting, ii, 454, 455, 456, 457, 464–468, 477, 480, 483; iii, 4, 8, 13, 14.

Unsoundness and warranty of internal organs, iii, 423.

Worms or parasites in, ii, 162, 170–174; drugs destroying, ii, 465, 466, 481, iii, 6, 12, 13; prescriptions, iii, 16, 17.

[See also titles Colic, Constipation, Diarrhœa; special organ, see its name.]

Intoxication septic form and poisoning, i, 481; iii, 55.

Intralobular vein of liver, i, 240.

Intra-membranous and intra-cartilaginous ossification of bones, ii, 178.

Intra-tracheal injections—administration of drugs by, iii, 18, 21; for horse-sickness, ii, 57; purpura hæmorrhagica, ii, 25; tetanus, ii, 49.

Intra-venous injections administration of medicine by, iii, 18, 22; for horse-sickness, ii, 57; parturient fever, ii, 99, 100.

Intrinsic causes of disease, i, 214, 215, 220.

In-turned hocks defect of, i, 89.

Invalid food—kinds, preparation, and administration, iii, 25–28, 140–142.

Invalid horses see titles Invalid Food, Nursing, Sick Horses.

Inversion of bladder, i, 371–373; rectum, i, 301, 302; uterus or womb, ii, 100–102; drugs for, ii, 478, 481.

Involuntary muscle—form of, ii, 305, 306.

Iodides—medicinal uses and action, ii, 475, 495; of arsenic, ii, 480; iron, ii, 447, 480; mercury, ii, 488; iii, 5; potash and potassium, ii, 448, 469; iii, 5, 10; sulphur, iii, 5.

Iodine medicinal uses, ii, 480; iii, 5; doses, iii, 10, 11; poisoning by, iii, 53.

Iodism—conditions producing, ii, 490.

Iodoform antiseptic uses, &c., ii, 421, 486, 489; iii, 166.

Ipecacuanha—medicinal uses, ii, 469, 471, 472; iii, 5; doses, iii, 10.

Iridectomy operation on eye, ii, 124.

Iris of eye form, muscle fibres, and disease, i, 11; ii, 109, 119, 123, 124.

Irish horses as hunters, i, 137, 138; iii, 201.

Irish ponies appearance, &c., i, 168.

Iron—medicinal uses, ii, 447, 448, 454, 456; iii, 1, 7, 9, 10, 11; as antidote, iii, 50.

Iron for horse-shoes, iii, 442.

Iron pipes, &c., used for stable drains, iii, 85, 86.

Iron splint for fore-limb fractures, ii, 247.

Iron stable fittings—use of, iii, 69, 324, 325.

Irons—for castration, iii, 173; for firing, iii, 160.

Irreducible hernia—description, i, 316.

Irregular bones—formation of, ii, 177.

Irritant poisons—list, and treatment of poisoning by, iii, 46–54.

Irritants as medicine, iii, 14.

Irritation—of bladder, remedies, ii, 475; skin diseases due to, ii, 139, 140, 142, 143.

Ischial tuberosity of buttock, i, 22; muscle connections, ii, 340, 341, 342.

Ischio-urethral muscle—action, ii, 73.

Ischium of pelvis—formation, ii, 192; fracture, ii, 257, 259.

Isolation in infectious disease, iii, 140, 153–156.

Isolation-boxes disinfection and structure, iii, 154–156, 320–324.

Itching due to barley diet, iii, 384, bedding, iii, 355, parasites, ii, 160, skin diseases and other symptoms, ii, 140, 140, 156, 164, 167; drugs relieving, iii, 2; stamping caused by, iii, 341.

J

Jaborandi—medicinal uses, iii, 5, 10.

Jacob—horse-breeding, &c., iii, 497, 519.

Jacobson, nerve of—origin, &c., i, 395.

James I and horse-racing, iii, 544.

Jaundice and its treatment, i, 304.

Jaw and jaw-bones—conformation, i, 8, 12, 40, ii, 185, 186, 188, disease of bone, ii, 180, 209, 210, 213, 215, 216; fracture and face cradle, ii, 239–242; joint, ii, 265, muscle connections, ii, 307–310, 312–314, 321; "lumpy" jaw, iii, 103; soundness examination, iii, 370, 372; swelling due to various causes, i, 264, 330; ii, 35, 40, 41, 44, 49. (Locked Jaw, see Tetanus.)

Jelly-fish and the evolution of man, &c., iii, 258, 479, 482, 483

Jennet descent from horse, iii, 533, 534

Jerking of limbs due to stringhalt, ii, 395

Jibbing due to bone disease, ii, 213.

Job-masters law of warranty, &c., iii, 417, 418.

Job's description of war horses, iii, 520.

Joint ill—see Arthritis.

Joint oil—see Synovia.

Joints and Articulations—anatomy ligaments, &c.

Classification and forms of joints, ii, 262, 263, 279.

Fetlock, coronet and coffin joints, ii, 272–274.

Glands causing flexibility of, ii, 127.

Head joints, ii, 265; head with neck, ii, 267–269.

Hip or coxo-femoral, i, 67; ii, 274, 275.

Hock-joint or tarsus articulations, ii, 277–279.

Joint oil (see Synovia).

Long- and low-jointedness—association between, i, 80.

Ribs—articulations of, ii, 266, 267.

Shoulder, elbow, and knee joints, ii, 270–272.

Special features in structure as compared with man, iii, 485–490, 491.

Stifle-joint or femoro-tibial, and tibio-fibular, ii, 275–277.

Tongue or hyoidal joints, ii, 266.

Trunk articulations, ii, 263–265

Warranty and soundness, iii, 420.

Joints, Muscles, Tendons, and Ligaments—diseases and injuries—
Accidents and first aid, ii, 439.
Breakdown of ligaments or sinews, ii, 251, 354.
Capped elbow, knee, and hock, ii, 359–364.
Causes and symptoms of joint diseases, ii, 270–284.
Contraction and spasm of muscle—causing fracture, ii, 222, 224, 226; in colic, i, 276; in rabies and tetanus, ii, 45, 48.
Defective action—causes of stringhalt, &c., ii, 305, 306.
Filled legs or œdema, ii, 364; lymphangitis or weed, ii, 22.
Fistula and pus among muscles—causes, &c., ii, 426, 430, 431, 433.
Fracture: muscle influence, &c., ii, 222, 224, 230, 237, 251, 252, 257; difficulty of setting due to large muscles, ii, 228, 233; prevention of fracture by thickness of muscle, ii, 242, 244, 254
Hæmoglobinuria: effects on muscular tissues—analysis, &c., ii, 27, 28
Heart muscles—inflammation, &c., i, 404, 408, 409
Hernia due to rupture of muscular structure, i, 324
Inflammation of joint membrane: synovitis), ii, 282–284.
Loose cartilages, or growths in joints, ii, 284, 285
Paralysis and effects, i, 418, 419; urine retention, i, 353; slight movement produced by drugs, ii, 478.
Poulticing directions, iii, 31, 32.
Roach back due to weak muscles, i, 57.
Skin cracks and swellings, ii, 141, 152.
Wasting of muscles due to disease, i, 311; ii, 30
[See also titles Anchylosis, Arthritis or "Joint Ill", Bone diseases, Bowed knees, Curb, Dislocations, Fractures, Knuckling over, Rheumatism, Sprains, Thoroughpin, Windgalls.]
Judging horses—acquiring knowledge for, i, 27.
Jugular ganglion—formation, i, 395.
Jugular vein of neck, i, 13; bleeding, i, 271; ii, 377; drugs injection, iii, 22; examination for soundness, iii, 372; muscle separating carotid artery, ii, 321; obstruction and thrombosis, i, 473, 475–477. pulse near, i, 462; iii, 140.
Jumping—action, forms, and hunters training, iii, 199–202, 308, 309; croup formation, i, 58; muscles used in, ii, 324; resulting in fracture, ii, 235, 236, 248, 249, overreach, ii, 309, sprains, ii, 289, 297, 354, thrombosis, i, 474.
Juniper—medicinal uses, ii, 474. oil dose, iii, 10.

K

Kairin—medicinal uses, ii, 450
Keeper of the Barbary horses—origin of title, i, 110.
Kell in scrotum due to hernia, i, 319.
Keratitis and its treatment, ii, 115, 116.
Kerato-hyoid muscle—form, ii, 315
Keratoma and treatment, ii, 372.
Key bit for hunters, iii, 307.
Kicking at night and in stables, iii, 140, 341; mange symptoms, ii, 167; mares during "horsing", iii, 181; muscles connected with, ii, 334, 339; prevention at operations, iii, 34, 159; warranty, iii, 424.
Kidneys—
Conformation and functions, i, 333–336; nerves and arteries, i, 377, 448.
Diseases—diabetes or polyuria, i, 340, embolism, i, 473; inflammation, i, 338, ii, 475; rupture and abscess, i, 343, 344; stone or calculus, i, 298, 370, 371; urine indications, i, 343, 344, 345.
Drugs affecting, ii, 440, 461, 473, 474, 475, 481, iii, 3; cantharides abuse, ii, 475.
Effects of disease—diarrhœa, i, 286, dropsy, i, 311, 312; filled legs, ii, 364, 365; hæmoglobinuria, ii, 30, horse sickness, ii, 57; skin disorders, ii, 138, spinal myelitis, i, 419; tuberculosis, ii, 51
Warranty as to condition, iii, 423.
King's interest in thoroughbred rearing and racing, i, 110–112
King's premiums for horse-breeding—conditions, &c., i, 140, 141
Kino—medicinal uses, ii, 455.
Kintyre Clydesdales—origin, &c., i, 199
Knees and Knee-joint—
Action—capabilities of hackney and harness horses, i, 121, 122, 152; defective action, ii, 400, 401; disease symptoms, ii, 301, flexion and extension, ii, 196.
Bandaging, iii, 37.
Bones and conformation, i, 69, 73–75, ii, 193, 196, 197, knee-cap and joints, i, 233; ii, 201, 202, 203, 271, 272, 275, muscles connected with, ii, 331, 332, special features and comparison to man, iii, 485–487, 489.
Bowed knees and other defects, i, 74, 75; ii, 303–305; iii, 375, sprain tendency, ii, 289
Broken knees, ii, 422, 423, 437; fraud and warranty, iii, 419, 418, 420, 421.
Capped knees, ii, 359–362.
Fracture of bones, ii, 247.
Growth measurements—table, &c., iii, 297.
House cartilages in joint, ii, 284.
Soundness and warranty, iii, 372, 374, 375, 379, 383, 419, 418, 420, 421.
Sprain of ligaments, &c., ii, 294, 354
Spring knee condition, i, 74; iii, 375.
Stable vices—injuries, iii, 342.
Various diseases affecting—arthritis, ii, 286, 287; mallenders and sallanders, ii, 157; splints, ii, 297—operation for, iii, 164; wind galls, ii, 355
Knives—for castration, iii, 173, 185; neurotomy, iii, 163, ovaries removal, iii, 181, 182; tenotomy, iii, 169, 170.
Knuckle-bone—see Astragalus.
Knuckling over at fetlocks, &c.—causes, ii, 53, 297, 298, 347, 355; unsoundness, iii, 372.
Koch's discovery of tubercle bacillus, ii, 50; use of antiseptics, ii, 487.
Konigsberg beans as food, iii, 449.
Kreatin and kreatinine in urine, i, 341, 342.

L

Labia—structure and glands, i, 18, 73, 74, 230, swelling and eruption on, ii, 53, 140.
Labour pains in foaling, iii, 270; drugs for, ii, 475, 481; flooding, &c., due to, ii, 87, 91
Laceration of eyelids, ii, 112, of muscles of thigh, ii, 305.
Lachrymal bone—form, &c., ii, 187
Lachrymal fossa, sac, and duct—formation, &c., ii, 187
Lachrymal gland of eye—diseases, ii, 114.
Lachrymal nerve—formation, i, 394.
Lacteal system—composition, &c., i, 425, 426–428, intestines, i, 236, 237, drugs affecting, ii, 2
Lacunæ in bone structure, ii, 176, 177.
Lady's hack—Arab merits, i, 203.
Lair suitable for breeding purposes, iii, 268.
Lake water—plants polluting, iii, 129
Laky blood—composition of, i, 431.
"Lamb, the"—height, &c., i, 94.
Lamellar portion of ligamentum nuchæ, ii, 264, 265.
Lameness
Causes and general treatment, ii, 388, acid used, ii, 452
Corns, contracted feet, hard cutlaces, and cracked heels, ii, 272, 304, 427, 435.
Defective action causing, ii, 301.
Diseased bone causing, i, 200; ii, 196, 207, 268, 269, 271, 284, 287; side bones and navicular disease, ii, 368, 369, 391.
Fractures causing, ii, 228, 244, 246, 250, 251, 257, 258, 259, 269, 301
Joint diseases causing, ii, 270, 281, 282, 284, 286, 287, loose cartilages, ii, 284, 285
Operations for—firing, iii, 166, 167, unnerving, iii, 161, 164, 165
Pricks and wounds to feet causing, ii, 386, 387.
Shoeing causing, iii, 453, 454.
Sprain symptoms, ii, 289, 292, 293, 294, 295, 296, 297, 299, 301, 302—chronic sprain not showing lameness, ii, 299
Symptoms of various diseases—canker, ii, 382; hæmoglobinuria, ii, 26, 29, 30, liver, i, 397; lymphangitis, ii, 22, quitter, ii, 379; rheumatism, ii, 21, sand crack, ii, 369, seedy toe, ii, 389, thoroughpin, ii, 358; thrush, ii, 374, villitis, ii, 384, womb inflammation, ii, 90.
Unsoundness and warranty—examination for and diseases producing, iii, 374, 375, 377, 413, 419, 421, 422, 423.
Lamina of sieve bone, ii, 176.
Laminæ dorsalis and ventrales—formation, iii, 250.
Laminæ of hair and horn—form, ii, 132, 133, iii, 434, 435, 470, diseases affecting, ii, 365, 372, 371.
Laminitis and its treatment, &c., ii, 376–378, other causes and results, i, 82, 290, ii, 90, 368, 369, iii, 24, 109, stallions, iii, 237, 238, unsoundness and warranty, iii, 376, 422.
Lampas—causes, treatment, &c., i, 7, 254, 326.
Lanarkshire—origin of Clydesdales, i, 199.
Lancet—use for blood-letting, i, 407, 475, 476, for rectum inversion, i, 301, 302
Land—for breeding and rearing, i, 112, iii, 207, 208, 210, 216; ponies, i, 155, 159.
Land carriage of horses—facilities and apparatus, iii, 404–407.
Lanoline as an ointment, iii, 42.
Large horses of Scotland—history, &c., i, 186, 187.
Large intestine—description and uses, i, 237, 238.
Large metacarpal bone—formation, ii, 197.
Large pastern bone—formation, ii, 198
Laryngeal nerves—formation, i, 391.
Laryngitis and its treatment, i, 507–509; iii, 15, cough, ii, 18, 19; cause of asphyxia, i, 495.
Larynx—conformation, bones and uses, i, 5, 434, 455, ii, 189, diseases and spasm, i, 507–509, ii, 2, 17, 18, drugs, iii, 6, 8, muscles, ii, 313, 315, 316, 317, removal for roaring, &c., i, 507, 509, 511, 512; soundness, iii, 380.

Latches for loose-boxes, iii, 325.

Lateral crico-arytenoid muscle—form, &c., ii, 317.

Lateral ligaments of various joints, ii, 272, 273, 279.

Lateral region of body, i, 16.

Lateral surface of head, i, 10–12.

Lateral ventricle of brain, i, 374.

Lateralis sterni muscle—form, &c., ii, 34

Lathyrus sativa as food, iii, 350.

Latissimus dorsi—nerve and muscle, i, 389; ii, 323.

Latrines for stablemen, iii, 320, 335.

Laudanum—medicinal uses, ii, 460.

Laws, &c.—ancient breeding, i, 173, 174, 187; iii, 5–7, 540–542, 545; manure removal, iii, 335; medicine and vivisection, ii, 441, 443; poisoning by yew, iii, 56; railway box disinfection, iii, 153; regulations for diseases, ii, 87–94; warrant and soundness (see Warranty).

Laxative foods for sick horses, iii, 26.

Laxatives—medicinal uses, iii, 14.

Lead—medicinal uses, ii, 454, 464

Lead compress for villitis, ii, 384.

Lead-poisoning and its causes, &c., ii, 464; iii, 51; drugs as antidotes, iii, 1, 6; paralysis due to, i, 420.

Lean head—form of, i, 36

Leaping—action and forms, iii, 199–202; hunter training, iii, 398, 399

Leather shoes—uses, iii, 420.

"Leave his legs behind him"—conformation causing, i, 85

Lecithin in blood, i, 432, 435

"Leedes Arabian"—history, i, 111.

Left heart—structure, &c., i, 437.

Left portions of abdominal cavity, ii, 336.

Left surface of head, i, 10.

Leg (or second thigh of hind limb)—conformation, i, 83, 85; nerves, arteries, and muscles, i, 393, ii, 343–345.

Legs—see titles Fore-limbs, Hind-limbs, Limbs.

Length of a horse—determination, &c., i, 95–98; of back, i, 55, 56; croup, i, 58, 59; head, i, 42; shoulder, i, 60, 70; proportions to height, i, 99.

Lens of eye, ii, 108; spots and disease, ii, 117, 119, 120; soundness, iii, 369, 370

Lenticular cataract—formation, ii, 120

Lentils as food, iii, 111–114.

Let down at belly—treatment of show horses, iii, 310, 311.

Letters on sale of horse—warranty, &c., regulations, iii, 405, 425, 426

Leucocytes—in blood, i, 434, in urine, i, 343.

Leucorrhœa and its treatment, ii, 92, drugs, iii, 5, 8

Levator muscles—distinction, &c., ii, 306, 307; forms: anguli scapulæ, i, 390, ii, 318; costarum, ii, 334; labii superioris and alaque nasi, ii, 308; menti, ii, 309; palati, ii, 310; palpebræ superioris, ii, 308.

Levers in equine locomotion—bones, &c., i, 33–35, iii, 103, 104.

Lice and their treatment, ii, 163, 166; iii, 357; drugs destroying, ii, 491; iii, 4, 7.

Lichen of the skin, ii, 148.

Licking the walls of stable—a sign of disease, i, 272.

Lieberkühnian follicles of intestine, i, 236, 237, 245.

Life—vital activity, existence, and evolution, iii, 479, 483, 484.

Ligaments—
- Diseases and injuries—(see title Joints, Muscles, &c., diseases).
- Displacement of bones prevented by, ii, 222, 223.
- Ligamentum nuchæ—(see that title
- Ossification causing "sole bones", ii, 387, 388.
- Structure of canon, i, 75, 76; fore-limb, i, 99, ii, 199, 223; neck, i, 12; pastern and foot, ii, 274; penis and sheath, ii, 71, 72; uterus, ii, 77, 78.

(See also titles Capsular, Check, Suspensory ligaments, Joints—anatomy, Sprains.)

Ligamentum nuchæ—formation and use, i, 53; ii, 264, 265; muscle connections, ii, 312, 313, 322.

Ligatures—for castration, iii, 175, hernia, i, 255, penis, ii, 83, veins, i, 502, wounds, ii, 476, 492, 115. See also Sutures

Light—eye examination, &c., ii, 107, 109, 111, iii, 142, 367, nervous influence, i, 387.

Light-coloured horses—bedding, iii, 350, feet diseases, ii, 305, 389, washing of, iii, 137.

Lighting of stables—see Stables

Limbs Conformation, &c.—
- Defective action and its causes, ii, 396–402, iii, 455–459.
- Development in embryo, iii, 255, 288–294
- Feather or hair—see Feather
- Flexion and extension—bones assisting in, ii, 293.
- Functions of the limbs, i, 67, 68.
- Grooming, washing, &c., in, 68, 135–137, 138
- Height proportions, and weight of body distribution, i, 92–95
- Length and rate of growth—before birth, iii, 288–294; after birth, iii, 294–297
- Model of hoof and limb, ii, 491.
- Soundness and form—examination and warranty for, iii, 372, 373, 376–386
- Special structure and comparison to man, iii, 485–490, of muscles, iii, 491, 492

(See also titles Fore-limbs, Hind-limbs, Action, Locomotion.)

Limbs—Diseases and Injuries—
- Bandaging, blistering, and firing, iii, 36–38, 39, 166.
- Bone diseases, ii, 296, 297, 210, 213, 210
- Defective action injuries, ii, 396–402; iii, 455–458.
- Enlargement or swelling—due to dropsy, i, 311, filled legs, ii, 304, glanders and farcy, ii, 36, liver disease, i, 314, purpura hæmorrhagica, ii, 25, lymphangitis, ii, 22–24, 62, rheumatism, ii, 20, 21, thoroughpin, ii, 237—drugs for swellings, ii, 442, iii, 1, 7.
- Jerking and stringhalt, i, 411, ii, 305; iii, 215, 367, 374, 423.
- Lime causing skin inflammation, ii, 143.
- Operations—for contraction and straightening, iii, 108–171, for mineving, iii, 161, 162; means for restraint, iii, 157, 159.
- Paralysis and crippling causes, i, 388; ii, 26, 39, 236, 237, 298
- Poulticing directions, iii, 31, 32.
- Trotters—bruises on, iii, 215
- Various diseases affecting limbs, ii, 22–24, 60, 62, 64, 143, 147, 157, 210, 376.

(See also titles Deformities, Dislocations, Fractures, Lameness, Sprains, for special parts of limb, see titles Feet, Knees, &c.)

Lime—as a medicine, ii, 448, 450; iii, 5, 9; antidote, iii, 45, 51, 52; "stone" formation influences, i, 345, 349, 354; iii, 124, skin inflammation due to, ii, 143; water tests, iii, 131, 132.

Lime juice, &c.—as antidote, iii, 51, 52.

Limit of confusion—skin as organ of touch, ii, 127, 128

Limited warranty—form of, iii, 406.

Lincolnshire horses—history, &c., iii, 54

Lincolnshire Lad II (1,165)—pedigree, &c., i, 184, illust., i, 200.

Linea alba of abdomen, ii, 335, 336.

Lineæ transversæ of abdomen, ii, 336.

Linen bandages—uses, &c., iii, 36.

Lingual glands and nerves—description, &c., i, 389, 390.

Liniments—application, &c., iii, 42; drugs used, ii, 450, 460; mouth trouble due to, i, 249

Lining membrane of heart—inflammation, i, 491–493.

Linseed and cake—as food, composition, &c., iii, 27, 60, 64, 99, 114, 115, 50; for broken wind, ii, 13; for medicine balls, iii, 15, 17

Linseed mashes—preparation, &c., iii, 26, 114.

Linseed oil—medicinal uses, ii, 444, iii, 5, 60; sick horse diet, iii, 27

Linseed poultice—preparation, and with bran, iii, 29.

Linseed tea—preparation, iii, 27, 114.

Lips
- Conformation and uses, i, 5, 220; muscle connections, ii, 307, 309, 311; nerves, i, 395; touch sensibility, ii, 128.
- Diseases, injuries, and eruptions, i, 247–249; bot-fly eggs on, ii, 170, fractured jaw, ii, 239, 240, herpes, ii, 140, horse-pox, ii, 43, pustules, ii, 141; stomatitis pustulosa, ii, 49; swellings due to diseases, i, 476, ii, 24, 55.

Twitch application, iii, 157.

Liquid ammonia—as stimulant, ii, 450, poisoning by, iii, 52

Liquid food—cause of disease, i, 221

Liquid medicines—administration, iii, 21.

Liquor arsenicalis—uses, &c., ii, 453, iii, 1.

Liquor folliculi of ovary, ii, 70.

Liquorice—uses in medicine, iii, 15, 17

"List" on back of Cleveland bays, i, 127, 132.

"Lister Turk"—history, iii, 540

Lister's antiseptic system for wounds, &c., ii, 407, 411, 420–422, 457.

Lister's strong mixture for wound treatment, ii, 410, 420.

Lithotomy operation—see Stone in the bladder.

Lithotomy tube—uses, &c., i, 306.

Lithotripsy—operation and instruments, i, 307–308.

Lithotrite—uses, &c., i, 307

Litter—see Bedding.

Liver—
- Condition bile effect on, ii, 446.
- Conformation and digestive uses, i, 238–241, bile-flow, &c., i, 245; capillaries and arteries, i, 447, 448; nerves, i, 377

Liver Diseases and Injuries
- Abdominal ascites—dropsy, i, 310–312.
- Congestion of liver, i, 303.
- Drugs affecting, ii, 450, 465–468, 488; iii, 6
- Fatty and ruptured liver, i, 308–310, 470.
- Inflammation or hepatitis, i, 305–308.
- Jaundice, icterus, the yellows, i, 304.
- Mustard plasters over liver, iii, 34.
- Signs of disease, iii, 149.
- Spasm of the diaphragm, i, 312.
- Temperaments liable to disease, i, 218.
- Tuberculosis and bacillus affecting liver, ii, 50, 51.

Liver Diseases and Injuries—*(Cont.*
Various diseases due to, &c.—diarrhœa, i, 256, digestive disorders, i, 272, 304, 307; filled legs, ii, 364, 365; giddiness, i, 409; hæmo-globinuria, ii, 27, 28, 29; influenza, ii, 32, œdema of sheath, ii, 84, skin diseases, ii, 139.
Worms and parasites causing disease, ii, 169, 171, 173, 174, 313–315; generation of, iii, 260, 261, 460
Liverpool bit—type and use, iii, 359.
Livery stable owners—law of warranty, &c., iii, 415, 417, 418.
Loads—drawing and position of limbs, &c., i, 67, 68, 85; hernia causes, i, 316, 319; merits of various breeds, i, 192, 193, 194, 266.
Lobelia—medicinal uses, ii, 472.
Lobules—of liver, i, 234, 240, of salivary glands, i, 270, 281, of testicle, ii, 60
Lobulus Spigellii position, i, 240.
Local authorities—disease regulations, ii, 57, 64.
Local diseases—classification, &c., i, 223, iii, 144
Local dropsy of sheath, ii, 83, 84.
Local inflammations of the skin, ii, 143, 146
Local paralysis causes, treatment, &c., i, 422.
Local symptoms of disease—definition, iii, 144.
Locality bump of, in a horse, ii, 430; disease influences, i, 213, 214.
Lock-jaw see Tetanus
Locomotion, Equine
Bones as levers, and effect of, i, 33–35, 490.
Footprints of various paces, iii, 107.
Forms and position in amble, canter, and trot, iii, 105, 106, galloping, leaping, and jumping, ii, 105, 202, standing and walking, iii, 191, 192, 194.
Muscles and head influences, i, 51, 56.
Nervous diseases causing failure, i, 405
Organs of locomotion see titles Bones, Limbs, Vertebræ, &c.,
Speed and centre of gravity, &c., i, 28–30, iii, 192–194
[See also titles Action, Movements.]
Lofts—structure, iii, 320, 322, 323, 326, 331.
Loins—conformation and defects, i, 14, 56, 57, 102; bones and fracture, ii, 174, 235, 236, lumbar nerves, i, 375, 377, muscles, ii, 319, 322–324, rheumatism in, ii, 21, spinous processes of, ii, 179, 180, spram, ii, 295.
London regulations on stable matters, iii, 83, 435, sale of horses and warranty, iii, 417
Long bones description and ossification, ii, 177, 178, fracture setting, ii, 229, 230.
Long conformation—of back, i, 54, 56, neck, i, 48, 50, pasterns, i, 80; shoulders, i, 69, 70.
Long low horse—appearance, &c., i, 99.
Longevity of cream Hanover horses, i, 206, 207, of Suffolks, i, 147, 148, 200.
Longissimus dorsi muscle—form, &c., ii, 306, 323, 324.
Longitudinal fracture—form, &c., ii, 221, 222.
Longus colli muscle—form, &c., ii, 322.
Loose cartilages in joints, ii, 284
Loose-boxes
Bedding causing heat and injury, iii, 356.
Care of hunters in, iii, 310, mare and foal, iii, 265, 268, 285, sick horses, iii, 23, 24, 143; trotters, iii, 310
Conveyance of horses—by land and rail, iii, 464–467; by sea, iii, 491, 492.
Infection, disinfection, and occupation afterwards, iii, 153, 154–156.
Shoes for animals in, iii, 139.
Loose-boxes—*Cont*
Structure, &c., iii, 69, 70, 323, 325—drainage, iii, 64, 85, plans, iii, 326–324, 325, racing stables, iii, 338, railway boxes, iii, 153, 464–467, sick-boxes, iii, 24, 25, 143, tramway stables, iii, 337.
"Lord Derby" 415—hackney stallion illust., i, 172.
"Lord Derby II" 417—pedigree, i, 111
"Lord Stewart" Clydesdale stallion illust., i, 2
Lost dog and horse story of Zadig, iii, 473–475
Lotions—application, &c., iii, 42 head preparations, ii, 464 See also Embrocations, Eyes, Liniments.
Lousiness—see Lice.
Low in front—conformation and effects, i, 45
Low neurectomy method, &c., iii, 101, 102, 104
Low ring-bone form of disease, ii, 2
Low withers—character of, i, 52–54
L-shaped stables plan, &c., iii, 322.
Lucerne hay—composition, &c., iii, 80, 90, ii, 97, 99, 109, 111.
Lumbago and its causes, &c., ii, 21.
Lumbar arteries—formation, i, 452.
Lumbar muscles of inferior region, ii, 324, 326
Lumbar nerves formation, &c., i, 381, 401, 402–405.
Lumbar portions of abdominal cavity, ii, 338
Lumbar rheumatism—symptoms, &c., ii, 21.
Lumbar vertebræ or spine formation and bones, ii, 174, 191, 182, nature, ii, 236, spine diseases affecting, i, 474, 475, kidneys position, i, 315, muscle connections, ii, 324, 326
Lumbo-aortic plexus formation, i, 377.
Lumbo-sacral plexus—formation, i, 402–405
Lumbricales muscle—form, &c., ii, 332
Lumps on skin, ii, 127, 146.
Lumpy jaw—causes, iii, 102.
Lunar bone form, &c., ii, 112, 197.
Lunar caustic uses, &c., ii, 457
Lunging in hunter training, iii, 307, 308.
Lungs
Blood distribution through capillaries and arteries, &c., i, 440, 448, 467, heart's action, i, 448.
Conformation and respiratory uses, i, 482–484, 486, 491, 494, conformation showing good lungs, i, 30, 207, 208; consideration in prescription of drugs, ii, 468, 469, fatal lungs, formation, iii, 258.
Diseases and injuries—see title Lung diseases and injuries
Drugs affecting, ii, 462, 468–470, stimulant and soothing remedies, ii, 470–472
Lungs—Diseases and Injuries—
Bleeding or hemorrhage, i, 501, 502, ii, 19, 159.
Broken wind, ii, 12–14, sound for detection, i, 460.
Bronchitis and asthma, ii, 1–4, 11.
Classification and general considerations, ii, 1.
Congestion and inflammation pneumonia, ii, 5–10, heart affected, i, 457, 462.
Drugs for, ii, 462, 468–470, iii, 11 stimulant and soothing remedies, ii, 470–472.
Embolism of lungs, i, 473; ii, 149.
Illustrations of diseases affecting, ii, 34, 42, 149
Pleurisy or pleuritis, ii, 14–17.
Lungs—Diseases and Injuries
Cont
Punctured—effect and causes, i, 497, ii, 254, 255.
Sick box bedding and temperature, &c., iii, 23, 24, 143
Tuberculosis and bacillus, ii, 42, 50–54.
Various diseases associated with diarrhœa, i, 276, glanders and farcy, ii, 41, 50, 52, heart affection, i, 457, 462, liver, i, 305, tetanus, ii, 45
Worm infesting lungs, ii, 174.
Lupus affecting the horse, ii, 150.
Luxation of bones—see Dislocation
Lying down as cause of capped knee and hock, ii, 200, 362, iii, 343
Lymph composition, &c., i, 435, 440, 441, vessels, i, 441
Lymphadenoma a form of tuberculosis, ii, 55.
Lymphangitis and its treatment, ii, 24 drugs in, ii, 470 specific fever, ii, 59, 60, distinction from glanders, ii, 35, 37, grease from, ii, 131, other effects, ii, 150, 422
Lymphatic animals disease liability, i, 214, ii, 424
Lymphatic glands and system composition, &c., i, 435, 440, 441, of bladder, i, 317, disease of "weed", ii, 222–224, 87 drugs for swellings, ii, 474, effects and swellings due to diseases, ii, 44, 58, 59, 62, soundness examination, iii, 374
Lymphocytes in blood, i, 434
Lysol for wounds, ii, 421

M

Machine-made shoes uses, iii, 446.
Maculæ of skin, ii, 136.
Mad staggers a form of indigestion, i, 280, 276, 281.
Maggots causing skin disease, ii, 163
Magnesia—medicinal uses, ii, 446, as antidote, iii, 45, water constituent, iii, 122
Magnesium, sulphate of see Epsom salts.
Maize as food composition, &c., i, 241, 242, iii, 80, ii, 102, 445, 446 digestibility, iii, 89, 90, 97, 98, 101, 110
Maladie du coit and its treatment, &c., ii, 52, 62, 63, 425.
Malar bone formation, &c., ii, 178, 187.
Malarial fevers—causes, i, 225, iii, 72.
Male fern—dose, iii, 10.
Male organs of generation—(see Reproduction).
Male pelvis—arteries of, i, 452
Male teeth—number, &c., i, 270.
Malformations see Deformities
Mallein for detection of disease, i, 227, ii, 35, 37, 55, 59, 61
Mallenders causes, &c., ii, 137, 138, chestnuts as, iii, 501, remedies, ii, 464, unsoundness, iii, 374.
Malleolus of tibia, ii, 200
Malpighi, capsule of formation, &c., i, 334, 335, 337
Malpresentations in foaling, iii, 274–279, of the tail, iii, 277–282
Malt liquors stimulating uses, ii, 468.
Malt sprouts as food, iii, 83, 102.
Maltose in digestion, i, 244
Mammalian ovum—formation and fertilization, iii, 251, 252, 258, 450–453
Mammary glands—conformation and development, i, 16, 17; ii, 94, 135; diseases affecting, ii, 53, 93–97, 182; fractured pelvis effect, ii, 257, use of alum, ii, 456, weaning effects, iii, 226. (See also Milk.)

Mammitis—treatment, &c., ii. 93–97.
Man—comparison of skeleton of horse, ii, 170; iii, 485–490; foot pads, iii, 502, 503, 507, 508; origin from jelly-fish, evolution influences, &c., iii, 257, 258, 479, 482–484.
Mane—characteristic of horse, growth, &c., ii, 132; iii, 435; mange, ii, 167; washing in disease, iii, 35.
Mange and its treatment, ii, 166–168, iii, 35; cure for, and mange mites causing disease, ii, 142, 163, 166, 167; drugs used, ii, 431, 434, 491; iii, 4; skin dressing causing, ii, 120; unsoundness and warranty, iii, 422.
Mangel-wurzel poisoning by, iii, 51.
Mangels as food, iii, 82, 115.
Mangers construction and tying in, iii, 327, 366, 338; cribbing and feet in, i, 414; iii, 342; food left in, and infection precautions, iii, 142, 154, 155; lip troubles due to wood, i, 247.
Mangolds—food uses, iii, 350.
Manholes—in stable drainage, iii, 85, 86, 89, 350.
Manure—see Dung.
Mares—
Blistering while "in season", iii, 39
Breeding and origin of various types of horses—ancient laws, i, 173, 174; Arabs, i, 201, 202; Clydesdales, i, 187, 189, 190; Flanders, i, 175, 176, 177; hackneys, i, 115, 119; harness horses, i, 152, 153; hunters, i, 125, 135, 136, 140, 142, 143; ponies, i, 157, 158, 161, 162, 163, 171; Shires, i, 172, 174, 177, 178, (illust.) iii, 268; Suffolks, i, 195.
Care and food, &c., of in foal mares, iii, 208–210, 215–218, 264–266; after foaling, iii, 226–228, 285; constipation, i, 285; weaning after fresh service, iii, 225; working during suckling and pregnancy, i, 286, 287; iii, 217, 264
Catheter insertion and uses, iii, 177, 179.
Causes of disease—sex influences, i, 218
Growth of foals—influence of mares, iii, 207, 208.
Mating and impregnation, iii, 213–215, 219, 234–238, 262, 263, 267, 268; artificial insemination, iii, 231–234; cantharides abuse, iii, 69; influence of first sire on further offspring, iii, 230–245.
Period for foaling, iii, 285
Stone in bladder, or vesical calculus, i, 368.
Troublesome mares, removal of ovaries, iii, 180–184.
[See also titles Œstrum, Parturition and Pregnancy, Reproduction Organs, Sexual Intercourse, Suckling of Foals.]
Market sales of horses—warranty as to, iii, 417.
"Markham Arabian"—history, &c., i, 110, 111.
Markings—forms and origin of special marks on horses, &c., iii, 405, 497–500; in Cleveland Bays, i, 127, 132; Clydesdales, i, 192; Suffolks, i, 196, 197; Yorkshire coach-horse, i, 134, teeth "mark", iii, 392, 393, 395, 400.
Marrow of bone, ii, 176.
Marsh lands—fever causes, iii, 78
Marston—shire horse, price, i, 185.
Martingale—use for harness and show horses, i, 151, iii, 313
Masculine features effect of castration, iii, 172
Massage diseases benefited by, ii, 286, 357, 365.
Masseter muscle—form, &c., ii, 309.
Masseteric nerve formation, i, 394
Master of the horse or stud—ancient appointment, i, 110, iii, 537
Mastication process and time, i, 233, 244, 246, 247; imperfect effects, i, 272, 282, 286; loss of power and difficulty due to diseases, i, 420, 504; ii, 44, 48, 49; mixed food, iii, 346; nerves and muscles assisting in, i, 385; ii, 310, 313; teeth effects, i, 326, 327, 330.
Mastoid process of temporal bone, ii, 165
Mastoido-auricularis muscle—form, &c., ii, 312.
Mastoido-humeralis muscle—form and uses, i, 409, 410; ii, 306, 320; fracture effects, ii, 245.
Materials for stable structure, iii, 319, 329, 333
Mating of mares—see titles Breeding, Mares
Matter—see title Pus or Matter.
Maxillary articulation—form, ii, 185
Maxillary bones—forms, &c., ii, 180, 185; fracture, ii, 242
Maxillary nerves forms, &c., i, 393
Meadow hay quality, &c., iii, 351, 352
Means of restraint of horses during operations, iii, 150–160.
Measures for drugs, &c., iii, 11, 12.
Mechanical apparatus—bowed knees, ii, 304; contracted feet, ii, 394, 395; malformed limbs, ii, 346, 347
Mechanical causes of disease, i, 219, 220; ii, 420.
Meconium plugging rectum of foals, i, 284
Median nerve and branches—formation, i, 400.
Median neurectomy—method, &c., iii, 101, 102, 104, 105.
Mediastinum testis—form, ii, 66, 67.
Medicinal plants—appearance of (illust.), ii, 466, 470
Medicines and Drugs—
Action and uses, ii, 441–444—list of drugs, iii, 1–8; therapeutical action of medicines, iii, 12–14.
Administration and preparation of physic, ii, 444–446; iii, 18; balls, draughts, drench, &c., iii, 19–22; electuaries, injections, and suppositories, iii, 21, 22, 41; refusal of horses, means of forcing, iii, 157, 158
Antiseptics and wound treatment, ii, 420–422, 483–485
Diseases due to abuse of drugs, i, 272, 279, 280; ii, 84, 143, 473, 475.
Doses, measures, and weights for various drugs—list of, iii, 9–12.
External remedies—gargles, liniments, &c., iii, 41–43
For acting on tissue change—alteratives, ii, 452–454; astringents, ii, 454–457.
For blood, affecting nutrition of entire body, ii, 446; tonics and reducing drugs, ii, 447–450; cooling medicines, ii, 450–452.
For blood-vessels, ii, 457, 462–464
For heart and blood-vessels, ii, 457–462.
For kidneys, bladder, and generative organs, ii, 473–475.
For lungs and air passages, ii, 468–472.
For nervous system: hypnotics, tonics, and stimulants, ii, 470–478; anæsthetics and anodynes, ii, 479–483.
For skin and "sweating", ii, 472, 473
For stomach, digestive system, bowels, and liver, ii, 464–468.
Infectious diseases—little value of, iii, 150, 151
Miscellaneous drugs for various ailments, ii, 458–461.
Operations, iii, 156, 157, 160, 182 (see also Anæsthetics).
Poisons and Poisoning—see that title.
Prescriptions—horse balls for various purposes, iii, 15, 16; powders, iii, 16, 17, draughts, iii, 18.
Medicines and Drugs—*Cont.*
Treatment of pregnant mares, iii, 266; ship-board horses, iii, 463; show horses, iii, 311; trotters in training, &c., iii, 316.
[For special drugs, &c., see their names.]
Medulla, and medullary cavity and foramen in bone structure, ii, 176
Medulla oblongata—formation, &c., i, 382, 399, 404
Medullary sheath, &c., of nerve-fibres, i, 379
Megacocci of bacteria, i, 226.
Megastoma—a form of worm, ii, 169.
Megrims—see Vertigo.
Melanosis—unsoundness due to, iii, 374.
Mellitus diabetes and treatment, i, 346.
Membrana decidua in uterus, iii, 253.
Membrana granulosa—form, iii, 248.
Membrana nictitans of eye, i, 11, ii, 103, 104.
Membranes—blue colour of, ii, 479; bone structure and disease, ii, 176, 208; brain—thickening of, i, 417; heart inflammation, i, 461–463; joint structure and inflammation, ii, 262, 282–284; lining stomach and intestines, i, 235, 236; lung diseases, ii, 1; poisoning and disease signs, iii, 46, 47, 48, 145; spinal cord diseases, i, 418; uterus during gestation, iii, 252, 253. See also Mucous membranes.
Memory of a horse, i, 300; ii, 439, 440.
Meningitis—of brain, i, 405–407; spinal and cerebro-spinal forms, i, 418, 423–425; drug for, ii, 477.
Mental nerve formation, i, 394; fracture effect, ii, 240.
Menthol—antiseptic uses, ii, 487.
Mercurial poisoning—causes, &c., ii, 489; iii, 45.
Mercury and preparations—used medicinally, &c., ii, 454, 486, 488; iii, 3, 5—doses, iii, 10; poisoning and antidote, ii, 489; iii, 45.
Merismopedia of bacteria, i, 226.
"Mesaoud"—Arab stallion (illust.), ii, 412.
Mesenteric arteries—formation and diseases affecting, i, 448, 452, 471, 477; parasites in, ii, 174
Mesentery of intestine, i, 236; hernia causes, i, 317, 322.
Mesohippus—fossil remains and horse origin, iii, 512
Mesorchium of testis, ii, 65.
Metacarpal arteries formation, i, 450.
Metacarpal bones shin or splint bones)—formation, &c., i, 20, 75, ii, 197–200, iii, 477, 478, 487; former uses and fossil remains, iii, 477, 478, 511, 513; bone diseases affecting, ii, 200, 210, 213, 216, 219; fracture, ii, 223, 248; joints formation, ii, 271, 272.
Metacarpal periostitis and its treatment, &c., ii, 219, 220.
Metacarpi muscles—forms, ii, 330, 331, 332.
Metacarpo-phalangial articulation, ii, 272.
Metacarpus—see Canon
Metal shoes—introduction, iii, 429.
Metallic sutures, &c., for wounds, ii, 419.
Metatarsal artery—formation, i, 453.
Metatarsal bones—formation, &c., ii, 204, 278; iii, 487.
Metritis and its treatment, &c., ii, 89–91, 97, 98; iii, 180
Metro-peritonitis and its treatment, &c., ii, 89, 91, 97, 98.
Microbes and micro-organisms see Organisms.
Micrococci—formation, &c., i, 226, 246.
Microscopical discoveries on causes of disease, i, 224–226.

Microstoma—a form of worm, ii, 169
Middle cervical ganglion—formation, i, 376.
Middle flexor of metacarpus or canon—muscle form, &c., ii, 331.
Middle gluteus muscle—form, &c., ii, 339.
Midriff—(see Diaphragm).
Military Horses—
Air-space in stables, i, 1, 80.
Disease treatment—epizootic lymphangitis, ii, 64; horse-sickness, ii, 53–58.
History on, i, 176, 210.
Maize diet, iii, 108.
Shoeing—history and injuries, iii, 429, 452.
Water amount, iii, 120.
[See also titles Cavalry, War.]
Milk—absorption by skin, ii, 130; antidote uses, iii, 45; foal-rearing with cow's milk, iii, 224, 225; sick horses' diet, iii, 25, 141.
Milk of mares—alum for drying up, ii, 456; hand-milking practice, i, 287; ii, 94, 96; microbes causing disease, i, 225; refusal of mare to feed foal, ii, 94; suppression causes, ii, 90, 93, 94–96, 98; various effects of disordered milk, i, 251, 285, 286, 287, 288, 289.
Milk-glands—(see Mammary glands).
Milk-syphon—use of, ii, 96.
Milk teeth—appearance, &c., iii, 393, 476; shedding causing tongue inflammation, &c., i, 252, 326.
Milky streaks across eye—disease signs, ii, 120; iii, 368.
Mill-dust for bedding, iii, 350.
Millers' horses liable to "stone", i, 300.
Mineral acids—food and digestion, i, 243, medicinal effects, &c., ii, 454, 467, poisoning effects, iii, 48.
Mineral matter in bone, ii, 175.
Mineral poisons and their effects, ii, 493; iii, 48.
Mines—contamination of air in, iii, 76, 77
Miocene formation horse origin, iii, 512.
Miohippus—fossil remains, and horse origin, iii, 512.
"Mischief"—Yorkshire coach horse (illust.), ii, 161
Misrepresentations and fraud in sale of horses, warranty, iii, 410.
Mistakes in sale of horses—warranty regulations, &c., iii, 400.
Mites causing skin diseases, ii, 163, 166–168.
Mitral valves—sounds and disease, i, 400, 404, 465.
Mixed concretions—forms, &c., i, 300.
Mixed food—advantages and uses, iii, 343–346.
Mixed hemorrhage—causes, &c., i, 501.
Mixed joints—form, &c., ii, 263
Modern horses—descent and position in animal world, iii, 471–484.
Mohammedan belief and uses of horse, iii, 533, 534.
Moisture in tissues—during "azoturia", ii, 27; in health, ii, 28; in hoof, iii, 140.
Molar glands—description, &c., i, 230.
Molar teeth—form, defects, and growth, i, 6, 230, 327–329, 332; iii, 389, 390, 397–399, 476, 494, of temporary teeth, iii, 394–396; fracture and decay, i, 330, 331.
Monads—generation of, iii, 259.
Monday morning disease—causes, &c., ii, 22, 364
Mongolian horse—appearance, &c., iii, 513.
Monk's-hood—medicinal uses, ii, 461; poisoning by, iii, 63.
Monorchid—description of, iii, 184.
Monro, foramen of—in brain, i, 384.
Moon-blindness and its causes, &c., ii, 116–118, 121.
Moorish horses—history, iii, 527, 530, 533, 534, 535.
Morbid conditions a sign of disease, i, 213, 214
Morgan horses—appearance, origin, &c., i, 207.
Morphia—injections and medicinal uses of, i, 280, 303, ii, 10, 459, iii, 5, 403—doses, iii, 10, fracture setting, ii, 230.
Morphine, acetate of—dose, iii, 9.
Mortality due to castration, iii, 186; epizootic lymphangitis, ii, 61, 63; influenza and pneumonia, ii, 32, 33; pyæmic arthritis, ii, 287, 288; parturient fever, ii, 99, worms in young animals, ii, 172.
Mortification of reproduction organs, ii, 87, 91, 92.
Mosquitoes causing horse-sickness, ii, 55, 58; paraffin-oil as protection against, ii, 58
Moss-litter—use of, iii, 138, 139.
Motion—gurgling sound during, ii, 71, nerves of motion, i, 392, 397, paralysis and causes, i, 419, ii, 236, 237. [See also titles Locomotion, Movements.]
Motor nerves—formation, i, 374, 385, 386.
Motores oculi nerves—formation, i, 385.
Motores oculorum nerves formation, &c., i, 392, 394
Mould causing disease, i, 216, 221; ii, 109, 371, iii, 102, 103.
Mouldy hay—effects of, iii, 102, 352, 353
Moulting—arsenic uses, ii, 454; rheumatism during, ii, 21
Mountain ponies—breeding lands for, iii, 210.
Mouth—
Conformation and examination, i, 5, 6–8; ii, 371, 372, bones and cavity, ii, 183, 186, 187; deformity, "parrot mouth", i, 331, harness horses, i, 151, muscles, ii, 307–309, 314.
Discharges—bleeding causes and aid, ii, 10, 439; froth and foam, ii, 56, 213; saliva secretion, &c., i, 258.
Drugs for mouth-washes, &c., ii, 50, 455, 457, 484, 485, iii, 2, 3, 5, application of mouth-washes, and poisoning treatment, iii, 41, 52.
Eruptions and diseases—facial paralysis, ii, 423; fungi or parasites, ii, 169; herpes, ii, 140; horse pox, ii, 43; stomatitis and thrush (aphthæ), i, 249–252; ii, 49, 50.
Poisoning effects, iii, 46, 47, 52.
Space between teeth—formation of, iii, 390, 494
Mouth-gag for physic giving, iii, 20.
Movements—
Absorbent system affecting muscular movement, i, 429.
Blindness and its tests, ii, 123.
Centre of gravity and equilibrium of a horse, i, 28–31; iii, 192–194.
Excitability denoted by ears, i, 42, 43.
Muscles in relation to power and speed, i, 31, 32.
Nervous system and brain influences, i, 373, 374, 390—diseases affecting power of movement, i, 405; reflex movements, i, 388, 389.
Poisoning effects, iii, 54.
Unsteady—due to heart, i, 458, staggers, i, 268, thrombosis, i, 474.
[See also titles Action, Defective action, Locomotion, Motion, &c.]
Mucous casts and mucus in urine, i, 345, poisoning signs, iii, 47, 48.
Mucous glands—description, i, 232.
Mucous membranes—bladder, i, 337; drugs affecting, ii, 454; iii, 2, 13; genito-urinary organs disease, &c., i, 344, 345; intestines, i, 236, liver disorders, i, 303, 304, 307; poisoning and disease signs, iii, 45, 145; stomach, i, 235, 273.
Mud—grooming of coat, &c., iii, 134–137, 310.
Mud fever—causes, &c., ii, 130, 144, 145, 150, iii, 135–137, remedies and precautions, ii, 464, 474; iii, 4, 310. (See also title Lymphangitis.)
Mule feet—formation and advantages, ii, 393.
Mulling of horses—early practice, iii, 172.
Multiplication processes in generation, iii, 258, 259.
Mumps in horses, i, 259
Muscles and Muscular System—
Action, origin, and insertion of muscles, ii, 306.
Appearance illusts., i, 390, 398; ii, 310, 314, 326.
Attachment to bones—tendons for, ii, 306.
Breathing uses, &c., i, 492.
Composition and kinds of muscles and fibre, ii, 305, 306—kreatin and glycogen in muscle, i, 341, 490.
Digestive influences, i, 235, 240.
Diseases and injuries—(see title Joints, Muscles, &c., diseases).
Drugs affecting, ii, 449, 478, 481; iii, 6, 13.
Examination for soundness, iii, 373.
In relation to power and speed, i, 31, 32; iii, 193; to locomotion, i, 33–35; iii, 191.
Moisture in tissue—analysis, &c., ii, 27, 28.
Nervous and absorbent systems affecting muscular movement, i, 373, 374, 429.
Regions—axillary, ii, 327; hyoid, ii, 312; lumbar, ii, 324; pharyngeal, ii, 315; scapular, ii, 328.
Skeleton attachments, i, 53; ii, 178, 180.
Special functions and structure as compared with man, iii, 490–492.
Sprains—(see that title).
[For muscles of special organ or part, see its title, as Abdomen, Fore-limbs, Neck, &c.; for particular muscle see its name.]
Musculo-cutaneous nerve—form, i, 404.
Musculo-spiral nerve—form, i, 400.
Musgrave's—gutters for stables, iii, 329; horse-tying in stables, iii, 328.
Mustard—medicinal uses, iii, 6.
Mustard plasters, &c.—preparation and application, iii, 33; for various uses, ii, 462, 469, 471, irritation due to, and question of use, ii, 3, 7.
Mutualism—a form of parasitism, ii, 160.
Muzzle for preventing bed-eating, iii, 139.
Muzzle of head, i, 5, warts and lip troubles, i, 248.
Mydriatics and their uses, iii, 14.
Myelitis, spinal—causes, &c., i, 418.
Mylo-hyoid muscle—form, &c., ii, 312, 313.
Mylo-hyoidean nerve—form, i, 404.
Myocarditis and its treatment, &c., i, 464, 468
Myotics and their uses, iii, 14.
Myrrh—medicinal uses, ii, 471; iii, 6.

N

Nags—uses of, i, 113, 118; iii, 543.
Nails as skin appendages, ii, 131, 133; iii, 504, 505.
Nails in foot—diseases and injuries by, ii, 210, 253, 385, 403, 412, 413; iii, 453–

Nails and nailing on of shoes, iii, 444, 450, 451; injuries, iii, 453

Nape of head - see Poll).

Narcotic poisons and treatment of poisoning by, iii, 54–64.

Narcotics drugs used as, ii, 476, 481.

Narrow conformation—of breast, i, 61, 62; croup, i, 59; face, i, 39; digestion influences, iii, 110.

Nasal bones—formation, i, 9; ii, 186; fossil remains, iii, 513; muscles attached to, ii, 302, 309.

Nasal catarrh or gleet—causes, treatment, &c., i, 495, 499–501; drugs, ii, 480; iii, 5, 7; mallein test, ii, 39; pus extraction, ii, 180; soundness examination, iii, 371

Nasal duct—position, i, 10.

Nasal nerve—formation, i, 393

Nasal peak formation, i, 9; ii, 186.

Nasal process fracture of maxillary bone through, ii, 242

Natural ventilation—use of term, &c., i, 496

Navel and umbilical opening—formation and dressing, i, 17; ii, 288, 335, 338; liver and hernia effects, i, 306, 310; "navel ill" and pyæmic arthritis, ii, 280, 287–289; separation at birth, iii, 270, 271.

Navicular bone formation, i, 22; ii, 260; fracture, ii, 224, 252; wounds affecting, ii, 385.

Navicular disease its treatment, &c., ii, 381–393; fracture and other effects, ii, 200, 252, 280, 373; operation for, ii, 161, 164, 165; unsoundness and warranty, iii, 370, 382, 422.

Navicular ligaments—coffin-joint, ii, 273

Naviculararthritis (see Navicular disease).

Near side explanation of term, i, 3.

Neck—
- Carriage and coupling of head and neck, i, 44–46, 48–51; ii, 267–269
- Conformation and bones, i, 12, 13, 47, 102; ii, 179, 181; arteries and veins, i, 447, 449; joints and ligaments, ii, 264, 265; joint with head, ii, 267–269; muscles, ii, 318–322, 326; nerves, i, 375, 376; spinous processes of, ii, 179, 180; weight of body influenced by length, i, 91.
- Diseases and injuries affecting covering disease, ii, 53; eczema ii, 148; fracture, ii, 235; horse sickness, ii, 55, 56; mange, ii, 172; nettle-rash, ii, 146; poll evil, ii, 430; roaring, i, 511; roping to extract horse from ditch, ii, 440; spasms, ii, 45, 47, 48.

Neck cradle used after blistering, iii, 30

Neck presentations in parturition, iii, 274, 279, 280.

Necrosis of bone, ii, 212–214, other causes, ii, 386, 431, 432; tuberculosis classed as, ii, 51

Needles causing heart disease, i, 461.

Needles for hernia, i, 318, lithotomy, i, 366, neurotomy, iii, 163, 164; skin injections, iii, 21; wound-stitching, ii, 418, 419.

Negative symptoms of disease, iii, 145.

Nematodes causing disease, &c., ii, 170, 171, 174, 370; drugs destroying, iii, 12

Nephritis and its treatment, i, 348; unsoundness and warranty, iii, 423.

Nerve-cells composition and uses, i, 375, 378, 386

Nerve energy or stimulus—generation, &c., i, 373, 387, 388; heart action, i, 441; ii, 458

Nerve-fibres—composition and uses, i, 375, 378, 379, 385, 386, 387, 494.

Nerve tonics and stimulants—drugs used, ii, 448, 477, 478; iii, 6.

Nerves and Nervous System—
- As essential to life, and composition of nerve tissue, &c., i, 373, 376, 387; in muscles, ii, 305.
- Blood supply, i, 374, 378, 380.
- Cerebro-spinal system, i, 373, 378; nerves—cranial, i, 391–397; spinal, i, 397; brachial plexus, i, 398–402; lumbo-sacral plexus, i, 402–405; structure—of cells and fibres, i, 378–420; of spinal cord, i, 380–382; of the bulb, pons, and brain, i, 382–386.
- Development in embryo, iii, 255.
- Diseases—(see Nervous Diseases, also names of diseases).
- Drugs affecting, ii, 470; anæsthetics and anodynes, ii, 479–483; sedatives and hypnotics, ii, 481, 497, 476; iii, 2 tonics and stimulants, ii, 448, 460, 477, 478; iii, 6
- Functions and stimuli of the system, i, 373, 374, 380–390; generation of energy, i, 373; heart influence, i, 449, ii, 456; impressions and impulses conduction, i, 370, 386; perspiration regulation, ii, 130; respiration functions, &c., i, 494
- Plexuses of nerves—formation, &c., i, 398.
- Sympathetic system and ganglia, i, 374, 375; nerves of cervical, dorsal, splanchnic, lumbar, and sacral regions, i, 375–378

(For nerves of special organ, see its name; for particular nerve, see its title.)

Nervous Diseases and Influences—
- Affections classed under, i, 405.
- Apoplexy and sunstroke, i, 412.
- Breeding influences—colour and markings on animals, iii, 497, 498.
- Causes of disease—excitement, i, 215, 222, 287; iii, 54, 149; shock, i, 220; temperament, i, 218, 511; ii, 477; temperature, i, 216, 217.
- Cerebritis or brain inflammation, i, 405–407.
- Crib-biting, wind-sucking, and weaving, i, 413–415.
- Digestive disorders and saliva secretion, i, 232, 233, 258; gastritis, i, 274
- Division of nerves—(see Neurotomy).
- Drugs—(see title Nerves).
- Epilepsy, eclampsia, and chorea, i, 410, 411.
- Fracture and sprain influences, ii, 228, 233, 252, 292; protection of nerves from injuries, i, 370.
- Giddiness, megrims, or vertigo, i, 407–409.
- Heart disease detection difficulties, i, 456.
- Loss of power—(see Paralysis).
- Meningitis—brain, i, 405–407; cerebro-spinal, i, 423–425; spinal, i, 418.
- Myelitis and spinal inflammation, i, 418.
- Parasites infesting nerve-centres, ii, 174.
- Poisoning effects, iii, 54
- St. Vitus dance and stringhalt, i, 411; ii, 395.
- Spasm of diaphragm, i, 313.
- Tumours and abscess in brain, bone, &c., i, 409, 415, 417; œdema or blood clot, i, 410; thickening of membranes, i, 417.
- Unsoundness and warranty—"nerved" horses, &c., iii, 370, 377, 410, 422.
- Various diseases associated with nervousness—anæmia, i, 479; asthma, ii, 11; collapse, ii, 477; cough, ii, 19; diarrhœa, i, 287; larynx affections, i, 507, 510, 511; skin diseases, ii, 130; roaring and whistling, i, 511; tetanus, ii, 45, 48.

Nervous temperament of horses, i, 218, 511; ii, 477; blistering restrictions, iii, 30; feeding and training considerations, iii, 94, 302

Nettle-rash—causes and treatment, ii, 143, 145, 146.

Neural arch of spinal column, ii, 179, 180.

Neuralgia causing saliva disorders, i, 258.

Neurilemma of nerve-fibres, i, 379.

Neurokeratin of nerve tissue, i, 387.

Neurosis of skin, ii, 156.

Neurotomy or neurectomy—advantages, methods, and instruments for "unnerving", iii, 161–164; for navicular disease, ii, 392; after-effects and detection, iii, 165, 376, 377, 419, 422

New Forest—extent, and pony-breeding in, i, 166, 169

New Forest pony—origin, appearance, &c., i, 166, teeth illusts., iii, 390, 400, 402.

Newmarket—origin as a race-course, iii, 540.

Newminsters—rearing and training methods, i, 112; iii, 304.

"Nimrod" on hunter qualifications, i, 136, 138, 140.

Nippers—(see Incisor teeth)

Nitrates—medicinal uses of amyl, ii, 463; mercury, ii, 428; potash, ii, 442, 462, 474; potassium, iii, 6; silver, ii, 457, iii, 10; poisoning by, iii, 53.

Nitre for glossy skin, ii, 453

Nitric acid—medicinal uses, ii, 467; iii, 6; doses, iii, 9

Nitrogen—in air, iii, 132; in food, i, 244.

Nitrogenous foods—value, &c., iii, 87, 89, 92.

Nitro-glycerine—medicinal uses, ii, 463

Nitrous ether—medicinal uses, ii, 462, 474; iii, 7; doses, iii, 10.

Noah—Arab horses chosen by, i, 201; Chinese history on The Flood, iii, 517.

Nocard, Prof.—on glanders and farcy, ii, 36; maladie du coit, ii, 52; valvular disease, i, 465.

Nœud vital of brain, i, 404

Non-articular bones—forms, ii, 178.

Non-cognizable forms of disease, i, 219.

Non-striated muscle—form of, ii, 306.

Norman Conquest and horse history, i, 195; iii, 537, 538.

Nose and Nostrils—
- Bleeding, i, 501, 503, 504; ii, 10; first aid, ii, 439; hereditary cause, ii, 158, 159.
- Conformation and examination, i, 9, 10, 30, 483; ii, 186; false nostril, i, 10; iii, 508; fossil remains, iii, 513; muscles, ii, 307–309.
- Discharges—due to catarrh, i, 497, 498, 499; glanders, ii, 36; horse-sickness, ii, 56; influenza, ii, 32; lungs, ii, 10; purpura hæmorrhagica, ii, 24; strangles, ii, 40.
- Eruptions and ulceration due to diseases, i, 503; ii, 35, 43, 49, 62, 141.
- Examination as to soundness, iii, 370, 371.
- Injections, and inhalation by nose-bags, i, 260; ii, 471; for bleeding nose, i, 504; catarrh, i, 498, 500, 501; ii, 480; horse-sickness, ii, 58; use of alum, ii, 456.
- Obstruction causing roaring, i, 511.
- Poking-out nose a sign of disease, i, 260, 266.

Nosology—definition of, i, 214.

Nuclei of nerve centres, i, 380.

Nucleus and nucleolus of nerve cells, i, 378, 379.

Nursing—aid and attendants' duties, ii, 381, 442; iii, 23, 24, 141, 154; clothing, water, and food for horse, iii, 24–28; unloading rectum per hand, iii, 34, 35; various applications used in, iii, 41, 42; washing the horse, iii, 35. (See also titles Bandages, Poultices, Sick-horses, Slings.)

Nut-galls—medicinal uses, ii, 455.

Nutrient artery in bones, ii, 176.
Nutrition of body—definition, and use of food, iii, 87, 102; value of various foods, iii, 96–101; embryo and fœtus, iii, 252, 253, 257; health maintenance, iii, 66; medicines affecting blood, &c., ii, 446–452; alteratives, ii, 452; ulcers due to defect of, ii, 420.
Nutritive value of various foods—tables, &c., iii, 96–101, 102.
Nux vomica—medicinal uses, ii, 475, 478, iii, 6—doses, iii, 10, 11; poisoning by, iii, 57.

O

Oak bark medicinal uses, ii, 455, iii, 10; as antidote, iii, 51.
Oat-hair concretions—forms, i, 300.
Oatmeal-and-water as food, iii, 28.
Oatmeal gruel preparation, &c., iii, 27.
Oat-straw as food, iii, 354; for bedding, iii, 354
Oats as food—amount and advantages, i, 241, 243; iii, 93, 107, 346, 347. chewing, i, 243. composition, iii, 80, 97, 98, 99; digestibility, &c., iii, 90, 91, 97, 99, 115, 119, indigestion restrictions, i, 273; diseases due to, i, 221, ii, 42, iii, 104 hay and oats as sole diet, iii, 343, 346; heat and force influences, iii, 100, 101; special diet for horses in training, iii, 303, 304. pregnant mares, iii, 265, 266, 285, trotters, 316
Obesity breeding and sterility influenced by, iii, 215, 216, 237.
Objective symptoms of disease, iii, 145.
Oblique fracture—form, &c., ii, 221, 222; of various bones, ii, 226, 249, 254, 269
Oblique muscles of eye, ii, 104.
Oblique pasterns—form, &c., i, 80.
Oblique processes of spinal column, ii, 180, 182.
Obliquus abdominis externus and internus muscles forms, &c., ii, 336
Obliquus capitis superior and inferior muscles forms, &c., ii, 319, 320.
Observation—power in evolution, iii, 479; story of Zävig and the lost animals, iii, 473–475.
Obstruction—choking and gullet, i, 265, 266; circulation, due to diseases of arteries, &c., i, 471–478. dilation of stomach, colic, and constipation causes, i, 277, 282, 284. eye tears, ii, 114. foaling difficulties, iii, 271–274; heart valves, &c., i, 463, 465, 466; ii, 5, 10. intestinal obstruction, i, 296–298, due to "stone" and worms, i, 300, ii, 171; liver, causing dropsy, i, 311. nasal, causing roaring, i, 511; skin, ii, 127; sterility causes, iii, 220; urine and urethral passage, &c., i, 301, 350, 357; use of catheter—precautions, iii, 178. (See also Foreign bodies.)
Obturator artery—formation, i, 452.
Obturator externus and internus muscles forms, &c., ii, 342.
Obturator foramen of pelvis, ii, 192.
Obturator nerve formation, i, 403.
Occipital artery—formation, &c., i, 451.
Occipital condyles and the support of head and neck, ii, 181, 184, 267.
Occipital crest of head, i, 4.
Occipital or occiput bone—form, &c., ii, 184. fracture, ii, 234
Occipito-atloid articulation—form, &c., ii, 267–269.
Occipito-styloid muscle—form, &c., ii, 314
Occult spavin—form of disease, ii, 216; unsoundness, iii, 385.
Occupation a cause of disease, i, 218.
Odd hocks defect, iii, 384.
Odd-toed animals—horse-origin, &c., iii, 476, 511.
Odontoid process of axis, ii, 181, 263, 268, 269.
Œdema of brain or choroid plexus, i, 414–416. eyes due to horse sickness, ii, 59. larynx, i, 507. legs, ii, 384, iii, 7. opium uses, ii, 480. sheath, ii, 83; ulcers and granulations due to, ii, 427.
Œsophageal nerve—formation, i, 596.
Œsophagus formation, &c., i, 10, 229; dilation causing vomiting, i, 265.
Œstrus equi and hæmorrhoidalis infesting digestive system, &c., ii, 169, 170.
Offers—early uses of oxen, &c., i, 173
Off-side—explanation of term, i, 3.
Offspring reverting back in breeding—see Back breeding
Oidium albicans—a cause of "thrush", i, 250.
Oil-cake as food, iii, 89, 94.
Oil globules of liver, i, 230, 309.
Oils—digestive processes and emulsification, i, 241, 245, 246, iii, 91, 97. food properties, &c., i, 241, 242, 244; medicinal uses and doses, i, 297, 302, 304, iii, 6, 10, vitriol for glossy skin, i, 247, ii, 453.
Ointments—application, &c., iii, 42, for ringworm, ii, 105.
Old horses dilation of stomach, i, 276; dropsy, i, 312; hernia, i, 322; inversion of rectum and uterus, i, 301, ii, 100; intestinal obstruction, i, 296, liver inflammation, i, 307, œdema of sheath, ii, 84, parturition difficulty, iii, 272, 273, teeth and age test, iii, 491.
"Old Traveller"—breeding history, i, 128
Oldenburgh horse—appearance, &c., i, 206.
Oleate of zinc and mercury, medicinal uses, ii, 456, 488.
Olecranon process of ulna, ii, 196, fracture, ii, 245; muscles attached to, ii, 330, 331.
Olfactory nerves and bulbs—form and uses, i, 385, 391, 484; bones connected with, ii, 180, 188
Olympic games inauguration, and uses of horses at, iii, 522
Omenta of stomach, i, 235. hernia causes, i, 316, 319.
One-toed animals—horse-origin from, iii, 511, 512.
Opacity of eye—disease symptoms, ii, 108, 115, 119, 120, examination for, iii, 368, 369.
Open surface drains for stables, iii, 84–86. gutters, iii, 529.
Opening the heels—in shoeing, iii, 441.
Operations—
Antiseptics and drugs used, ii, 483, 484, 486, 487, 488, iii, 3, 4, 150, 157, 160; restorative in anæmia, ii, 459. (See also title Anæsthetics.)
Control of horses and means of restraint, iii, 156–160.
Deformed limbs and contracted tendons, iii, 168–171
Depriving certain part of sensation—unnerving methods, iii, 164–166
Foaling—malpresentations, iii, 272–282; mechanical aids, iii, 282–284, use of force, iii, 284.
Lameness and foot diseases, iii, 166, 167.
Shoes and shoeing—(see that title).
Table for, iii, 160
Urine removal, iii, 177–180.
[See also titles Anæsthetics, Castration, Catheter, Cautery, Firing, Lithotomy, Neurotomy, Ovariotomy, "Stone", Tenotomy.]
"Ophelia"—hackney mare, illust., i, 366.
Ophthalmia—forms and treatment, ii, 114, 119–123; hereditary, iii, 215, unsoundness—examination and warranty, iii, 363, 422.
Ophthalmic nerve and branches formation, &c., i, 515.
Ophthalmoscope—use of, ii, 107, 119, 120, 122, 123.
Opisthotonos tetanus form of, ii, 47.
Opium—medicinal uses and effects, ii, 479, 471, 472, 474, 475, 476, 479, iii, 5, 6—doses, iii, 10, 11, colic and intestinal disorders, i, 280, 282, 292, 294, 297, hernia, i, 324, poisoning by, iii, 55.
Optic nerves—formation and uses, i, 385, 391, 515, eye structure, ii, 105, 107, examination and disease, ii, 119, 122, 123, iii, 378.
Optic thalami of brain, i, 383, 384, 390.
Optical appliances for examination of eye, ii, 109–111, 119, difficulty in using, ii, 109
Oral evidence and warranty regulations, iii, 405, 407–409, 413, 420.
Orbicularis oris—form of muscle, ii, 307, 309
Orbicularis palpebrarum muscle of eyelid, ii, 302.
Orbit—cavity formation, i, 11, ii, 183, 187. eye anatomy, ii, 103
Orbital arch and process—formation, i, 11; ii, 164; fracture affecting, ii, 238
Orbital maxillary nerves—formation, i, 393.
Orchitis and its treatment, ii, 86.
Organic acids and food digestion, i, 243
Organic bodies—constitution of, iii, 87.
Organic life—nervous system of, i, 374
Organic matter in bone, ii, 175
Organisms Germs, Microbes, &c.]
Air—before and after respiration, i, 487; composition and pollution in stables, &c., iii, 77, 78, 131, 132.
Antiseptics, disinfectants, and drugs destroying, ii, 420, 452, 483, 484, 488, iii, 2, 3, 13—table showing strength, ii, 426, 487.
Causes of disease, i, 214, 216, 223, 224; ii, 160, iii, 78, 102–104, 124–126, infectious diseases, iii, 150–152.
Digestion and food forms infesting, i, 216, ii, 169–175, iii, 102–104, uses in intestinal digestion, i, 246
Diseases due to—anthrax, ii, 41, 42, 43; aphthæ, i, 250, covering disease, ii, 52, dysentery, i, 290, epizootic lymphangitis, ii, 59, 60, 61, glanders and farcy, ii, 34, 35, 37, joint diseases, ii, 280, 287, 288; liver, i, 306, 313–315; South Africa horse-sickness, ii, 54, strangles, ii, 49, tetanus, ii, 46; tuberculosis, ii, 50, 51, ulcers, ii, 420, womb and parturient fever, ii, 90, 97.
Distinction of parasites, ii, 159, 160.
Generation and evolution—growth, &c., iii, 258, 280, 479–484, alternate generation, iii, 259–261, spontaneous generation, i, 225.
Hygienic destruction of, iii, 65
Staining for examination, ii, 54, 60
Water composition and pollution, iii, 126–130, 132, disease influence, iii, 124–126.
Wounds infested by, ii, 406, 407, 411, 412, 413, 414
[See also titles Bacteria, Parasites, for special organism, see its title.]
Organs having no obvious use—evolution and other influences, iii, 509.
Orifices of stomach and intestines, i, 234, 235, 238—rupture, i, 315

Origin of muscles –description of term, ii, 306.
Origin of the horse –(see titles Ancestors, Evolution, History).
"Orme" 1889 –pedigree, i, 111; tongue inflammation case, i, 252, 325.
"Ormonde"–chest measurements, i, 65.
Orohippus fossil remains, iii, 510, 511, 512.
Os calcis see Calcaneum.
Os cervix –sterility causes, iii, 263.
Os coronæ form of bone and joint, ii, 193, 199, 273; deformity caused by, ii, 346, 347.
Os femoris– form of bone, ii, 201; see also Thigh.
Os hyoides form of bone, i, 6, ii, 189.
Os magnum bone of fore-limb, ii, 193, 197.
Os metacarpi magnum–form of bone, ii, 197.
Os naviculare –form of bone, ii, 193, 200.
Os pedis–form of bone, ii, 193, 199; muscle insertion, ii, 332, 333, 343.
Os suffraginis bone formation, ii, 193, 198; disease affecting, ii, 210; fracture, ii, 224, 249; joints formation, ii, 272, 273.
Os uteri externum of uterus, ii, 76.
Osmosis process in breeding, iii, 252, 254; in food solution, i, 427.
Ossa innominata of pelvis, ii, 183, 192.
Ossification of bones, ii, 178–of skull, radius, and ulna, ii, 183, 195, 196; before birth, iii, 255; conformation and action causing, i, 80; ii, 397; fracture influences, ii, 223, 248; joint disease, ii, 281; side-bones and ligaments, ii, 387, 388; strained muscle and spavin, ii, 293, 299; unsoundness and warranty, iii, 422.
Osteo-porosis and its symptoms, &c., ii, 214–216; fractures due to, ii, 224, 250.
Ostitis and its treatment, ii, 268, 210–212.
Ottorhægia a form of bleeding, i, 501.
Outer maleolus of tibia – ligaments attached to, ii, 277.
Ovaries construction and ligaments, ii, 77–79; arteries, i, 452; development of ova in, iii, 246, 248; removal–causes and operation, iii, 180–184; sterility and œstrum causes, iii, 229, 262. (See also titles Cystic ovaries, Ovum.)
Ovariotomy in troublesome mares, iii, 180–184.
Overreach as defective action, ii, 308; injuries, and shoes for correction, iii, 457; unsoundness, iii, 381.
Ovisacs of ovary, ii, 78, 79.
Ovum, human –development of, iii, 251, 252, 258, 480–483.
Ovum of mare formation and fertilization, &c., ii, 79, 80, iii, 245, 249, 258, 479, 480–483; sterility causes, iii, 230.
Oxalate of lime in calculus or stone, 354; in urine, i, 345, 346.
Oxalic acid –in urine, i, 346; poisoning by, iii, 51.
Oxaluria and its causes, &c., i, 346.
Oxen–choking, i, 265; digestive powers, iii, 96, 97; farm uses, i, 172, 173, 187; foot formation, iii, 476, 477.
Ox-gall in jaundice treatment, i, 305.
Oxide of zinc medicinal uses, ii, 456; dose, iii, 10.
Oxidizing agents–antiseptics, ii, 421.
Oxygen–in air, iii, 132; water purification, iii, 126.
Oxyurus curvula infesting intestines, ii, 171.
Ozœna –causes, &c., i, 409; alum uses, ii, 456.

P

Pacing–form of motion, iii, 195.
Pacing stallion "Star Pointer" (illust.), i, 336.
Pack horse "Triumph II" illust., i, 100.
Pack horses–appearance, &c., i, 123–125, Dartmoor and Arab crosses, i, 163, 204.
Paddocks for thoroughbreds, i, 112.
Pads in formation of foot–man and animals compared, iii, 501–504, 506, 508.
Pain control of horses during, ii, 437; drugs subduing, ii, 459–iii, 5, 8, 12; poisoning symptoms, iii, 47.
Paint–poisoning by, iii, 49.
Palate–conformation, i, 7; congestion, i, 254; muscles, ii, 188, 315, 316; parrot mouth effect, i, 332.
Palatine bones of face, ii, 187.
Palatine nerves formation, i, 393.
Palatine process of jaw-bones, ii, 186.
Palato-glossus muscle–form, &c., ii, 315.
Palato-pharyngeus muscle – form, &c., ii, 316.
Palmar pad–formation, iii, 502–504, 506, 508.
Palpation test for dropsy, i, 311.
Palpebro-nasal nerve form, i, 393.
Palpitation of heart, i, 407, 408; due to dropsy and anæmia, i, 311, 479; sound mistaken for, i, 312.
Pancreas description and digestive uses, i, 241, 245, 246; drugs affecting, ii, 264; worms in duct, ii, 171.
Panniculus carnosus muscle–form, &c., ii, 335.
Papillæ of foot, iii, 436; of skin, ii, 125, 126; growths causing disease, ii, 372, 381.
Papules –on skin, ii, 137, 147, 148.
Paracentesis for dropsy treatment, i, 312.
Paraffin-oil as protection against mosquitoes, ii, 58.
Paragoric elixir –medicinal uses, ii, 460, 480.
Paralysis–
Definition of term, i, 410.
Drugs–as remedies, ii, 490; iii, 6; causing paralysis, ii, 463; producing slight movement, ii, 478.
Eyes and lids–tests for, iii, 367, 368.
Forms of cerebral, spinal, and nerve paralysis, i, 405, 420–423; spinal meningitis, i, 415; cerebro-spinal meningitis, i, 423–425; penis paralysis, ii, 82, 83, 85.
Fracture effects – back, broken or sprained, i, 388; ii, 235, 236, 268; hind-quarters, ii, 236, 237; jaw and lip, ii, 240; skull, ii, 234.
Larynx affections, i, 507, 509, 510; ii, 17.
Litter or bedding for, iii, 24.
Poisoning causing, iii, 51, 59, 60, 64.
Use of catheter in, iii, 179.
Various causes or results – bladder, i, 298; covering disease, ii, 53; hæmoglobinuria, ii, 26; indigestion and staggers, i, 268, 269, 270; reflex movements, i, 388, 389; respiratory muscles, i, 495; roaring and whistling, i, 506, 510, 512; shoulder slip, ii, 350; thrombosis, i, 474; urine and fæces retention, &c., i, 16, 351.
[See also Facial paralysis, Local paralysis.]
Paramecium generation of, iii, 250.
Paraphymosis and its treatment, ii, 80.
Paraplegia and its causes, &c., i, 421; ii, 236, 237.
Parasites and Diseases due to–
Alternate generation of worms, &c., iii, 260, 261.
Causes of disease, iii, 149; anæmia, i, 478, 479; aneurism, i, 477; arteries and veins, i, 471, 472; colic, i, 279; diarrhœa and dysentery, i, 286, 291; epilepsy, i, 411; epizootic lymphangitis, ii, 59, 60; infectious diseases, iii, 152; indigestion, i, 272; seedy toe, ii, 379, 371.
Circulatory system, blood, and eye, ii, 174, 175.
Classification, introductory remarks, and terms used, ii, 159–171.
Digestive system, stomach, and intestines, ii, 161–163, 167, 174.
Drugs and antiseptics destroying, ii, 453, 461, 463, 484, 485, 486, 491; iii, 5, 7, 8.
Food and water as causes of disease, iii, 102–104, 125.
Liver diseases, i, 307, 313–315; parasites causing, ii, 169, 171, 173, 174.
Skin and external parasites, &c., ii, 140, 142, 163, 166; bee and mange, ii, 166–168; ringworm, ii, 140, 163, 166.
Washing in parasitic diseases, iii, 55.
Parental influences in breeding, iii, 211, 212.
Paresis of the bowels, i, 246.
Parietal bones forms, ii, 184; fracture, ii, 234.
Parieto-auricularis externus and internus muscles forms, &c., ii, 311, 312.
Paring the crust in sand crack, iii, 455. (See also title Shoes and shoeing.)
Park hacks–appearance, &c., i, 148, 149, 200.
Parole evidence and warranty regulations, iii, 405, 407–409, 413, 426.
Parotid duct–fistula of, i, 261–263, ii, 429.
Parotid glands –formation and use, i, 5, 11, 230, 231, 244; inflammation, i, 259–261; muscle connection, ii, 312.
Parotido-auricularis muscle form, &c., ii, 312.
Parotitis and its treatment, i, 259–261.
Parrot mouth –deformity, i, 331.
Partial dislocation–form, &c., ii, 346, 349.
Partial fracture–nature and treatment, ii, 221, 225, 249, 261.
Parts of a horse–names and divisions, i, 2–4; various views, i, 13, 14, 21, 22.
Parturient fever–causes, complications, symptoms, &c., ii, 90, 97–100.
Parturition and Pregnancy–
Accidents, abortion, premature foals, &c., iii, 221, 226–269–twins and deformities, iii, 273, 282.
After-birth–removal, &c., ii, 88, iii, 220, 251, 253, 270, 271.
Artificial insemination, iii, 231–234.
Birth of foal, iii, 219–222, 269–271; difficult delivery, iii, 271–274, malpresentations, iii, 274–279, of head, iii, 279–282, mechanical aids and use of force, iii, 282–284.
Care and food of in foal mares, iii, 208–210, 215–218, 228, 264–266, after foaling, iii, 226–228, 285.
Drugs assisting, &c., ii, 449, 451, 463, 475.
Expansion of passage and muscles assisting in parturition, ii, 74, 336, 337.
First signs of pregnancy and foaling, iii, 263, 264, 269, 270.
Growth of embryo and fœtus, iii, 249–257, 288–295.
Impregnation and changes in ovum, ii, 79, 80, iii, 245–249, 261–264.
"Slipping the foal", iii, 267.

Parturition and Pregnancy—*Cont.*)
Time for dropping of foals, iii, 219, 285.
Various diseases due to, i, 218—anæmia, i, 479; diarrhœa, i, 286; flooding, &c., ii, 87; iii, 266–269; hernia, i, 324; mammary glands, ii, 94; inflammation of bladder and womb, i, 340; ii, 89, 90, 91; inversion of bladder, i, 371; rectum, i, 301; uterus, ii, 109; joints synovitis, ii, 280; parturient fever see that title.
[See also titles Embryo and fœtus, Foals, Mares, Uterus or Womb.]
Past horses—ancestors, forms, and history, iii, 471–484, 509–513, 517–520
Pasterns—
Conformation and bones, i, 21, 79–81, ii, 198, 199; compensating points, i, 103; joints formation, ii, 272, 273; ligaments, ii, 274, measurements from, i, 91; muscle connections, ii, 331, 332, 333, 343, 344, 345.
Diseases affecting, &c.—bone-spavin, ii, 217; broken knees, ii, 422; horse-pox, ii, 43, ostitis, ii, 210; ring-bone, ii, 205, 206, stringhalt, ii, 305.
Displacement or dislocation, ii, 222, 349, 352.
Fracture and effects, ii, 205, 223, 224, 226, 229, 230, 249, "split" pastern, ii, 249.
Pasteur—bacteria researches, i, 225, 226
Pasture and Grass—
Advisability of turning horses out to grass, iii, 95
As food composition and properties, i, 241, iii, 89, 90, 91—for breeding stock, iii, 208, 210, 216, 217, 548, hunters and at night, iii, 307, 310; pregnant mares, and foals afterwards, iii, 208, 216, 228, 265, 266, 285; sick horses, iii, 26, use of ensilage or "pitted" grass, iii, 115–118.
Diseases due to or treated by—anæmia, i, 479; anthrax, ii, 42, 43; "big head", ii, 214, colic, i, 283; dropsy, i, 310; hæmoglobinuria, ii, 30; horse-sickness, ii, 54, 55, 58, indigestion, i, 272; liver, i, 308, 309, parasitic diseases and worms, ii, 161, 173, 174, pus in guttural pouches, i, 500; thrombosis prohibitions, i, 479.
Disinfection after disease, iii, 156.
Lands best for breeding, iii, 207, 208, 216, 217, 548
Lime and the sources of calculi, i, 298, 355
Poisoning contracted on, iii, 51, 53, 62.
Pony-rearing on commons, &c., i, 154, 157, 162, 163; iii, 541.
Quality and disease causes, iii, 102.
Shoes and the care of feet during pasturing, iii, 139
Teeth and urinary effects, i, 327, 338.
[See also Hay, Clover, &c.]
Patella—conformation, &c., i, 23; ii, 202, 351; iii, 487; dislocation, ii, 349, 351–353; joint formation, ii, 275, 276, muscles connection, ii, 340, 341; soundness, iii, 383.
Patellar ligaments of stifle-joint, ii, 276.
Patent defects — warranty restrictions, &c., iii, 411–413
Pathetici nerves—forms, i, 385, 392.
Pathognomonic symptoms of disease, iii, 145.
Pathology—definition and scope, i, 213, 214, heart diseases, i, 453–458, 460.
Paving of stable floors, iii, 326, 327.
Pawing in stable—correction, iii, 342.
Peak of the elbow, ii, 195.
Pearl barley as cooling drink, iii, 28
Peas—as food, iii, 89, 112–114, digestibility, i, 273, iii, 90.
Pease as food, iii, 350.
Peat-moss as bedding, iii, 24, 356.
Pectineus muscle form, &c., ii, 341.
Pectoral muscles—forms, &c., ii, 327; nerve connected with, i, 399.
Pedal artery—formation, i, 453.
Pedal or coffin bone—form and joint, i, 22, ii, 199, 200, 273, 491, iii, 436, 437, coffin, ii, 375, flexure and deformity, ii, 340, 347, horn tumour, ii, 372, 374, lameness and navicular disease, ii, 300, laminitis, ii, 370, 377, pricks and nail-wounds, ii, 385; sidebones, ii, 387, 388.
Pedigrees—
Ancient history and origin of horses, iii, 518, 519, 533, 534
Famous horses — Confidence and Fireaway, i, 122, 123; Denmark and Lord Derby II, i, 118, 119, Hermit and Orme, i, 110, 111; Speciality, i, 128, Stockwell and St Simon, i, 114, 115.
Records, &c.—Arabs, i, 201, 202, Cleveland Bays, i, 128–130, "creams and whites", i, 206, 207, hackneys, i, 114, 115; hunters, i, 135, Morgans, i, 207; Suffolks, i, 194, 195; Yorkshire coach horses, i, 134.
Thoroughbreds—tracing from three distinct sources, iii, 547, 548, 549.
Peduncles of brain, i, 385.
Pelham bit use of, iii, 358, 359.
Pelias berus causing poisoned wounds, ii, 415.
Pelodera Axei causing seedy toe, ii, 379, 371.
Pelvis—bone and conformation, i, 58, 59, 82, 83, 84, ii, 191, 192; female arteries and cavity, i, 452; ii, 193, fracture, ii, 225, 226, 256–260, male arteries, i, 452, muscle connections, ii, 325, 329, 341, 342, nerves, i, 377.
Pelvis of kidney—form and uses, i, 334, 335; stones in, i, 298.
Penis—amputation or castration, ii, 85; iii, 173; catheter insertion, iii, 177–179; conformation and use, i, 18; ii, 69–71; covering disease, ii, 52, 53; enclosure and inability to withdraw, ii, 80, 82, ligaments, muscles and tunic, ii, 72, 73, 335; paralysis, ii, 85, urinary tube, i, 333.
Pepper—medicinal uses, ii, 462.
Peppermint—medicinal uses, ii, 464, oil of, dose, iii, 10
Pepsin—medicinal uses, ii, 464, 465; iii, 7.
Pepsine in digestion, i, 235, 245.
Peptic gland—form, &c., i, 234, 235.
Percheron horse—appearance, &c., i, 205, 06, Schleswig cross, i, 210.
Perchloride medicinal uses of iron, iii, 450, mercury, ii, 486, 488—doses, iii, 10, 11
Percussion for detection of heart disease, i, 455, for pneumonia, ii, 8.
Perforans and perforatus muscles and tendons — see Flexor perforans, &c.
Pericarditis and its treatment, i, 461–463.
Pericardium of heart, i, 436; disease and inflammation, i, 454, 457, 460, 461–463.
Perineal needle for lithotomy, i, 366.
Perineum — conformation, i, 15, 16; "stone" affecting, i, 368.
Periodic ophthalmia and its treatment, ii, 116–118.
Periosteotomy for splints, ii, 208.
Periosteum of bone, ii, 170, 208, diseases affecting, ii, 207, 208, 210, 219; preservation in fracture treatment, ii, 233.
Periostitis and its treatment, ii, 208–210, metacarpal form, ii, 219, 220
Peripheral paralysis—form, &c., i, 420, 422.
Perissodactyla or odd-toed animals, iii, 476, 477, 510, 511.
Peristalsis of food in stomach, i, 235.
Peristaltic action of bowels — drug affecting, ii, 483; iii, 13.
Peritoneum of liver, i, 238, stomach and intestines, i, 235, 236, uterus and inflammation, ii, 77, 99, 91; testis, ii, 65.
Peritonitis—colic and "tapping" causing, i, 283, dropsy sequel, i, 310.
Permanent teeth form, &c., iii, 389, 390–392, 393, 396–399
Permanganate of potash antiseptic, uses, &c., ii, 421, 449, 450.
Peroneus muscle form, &c., ii, 343
Peroxide of hydrogen as an antiseptic, ii, 421
Peroxide of iron as an antidote, iii, 50.
Persian horses history and uses, iii, 528, 529, 532.
"Persimmon"—descent, iii, 548.
Perspiration and patchy sweats — (see Sweating).
Peruvian bark—medicinal uses, ii, 467.
Pessaries bladder treatment, drugs for, ii, 475
Petrifactions—horse remains in, iii, 471, 472.
Petrous temporal bones — formation and joints, ii, 184, 185, 266.
Phagedænic ulcer—form, &c., ii, 427
Phagocytes in blood corpuscles, i, 433.
Phalanx of fore-limb and foot — formation, &c., i, 22; ii, 198–200, 272, 273; iii, 476, in comparison with man, iii, 487–490, fossil remains, iii, 513
Pharyngeal nerves—form, i, 395, 396.
Pharyngeal region muscles of, ii, 315, 316
Pharyngitis and its treatment, i, 254–257; abscess and pus due to, i, 257, 504
Pharynx — conformation, i, 5, 229; muscles, ii, 315, 316; obstruction causing choking, i, 266.
Phenacetin—medicinal uses, ii, 459.
Phenacodus form and horse origin, iii, 510.
Phenic acid, &c.—forms of carbolic acid, ii, 484
"Phenomena" hackney records, i, 117.
Phlebitis—treatment, &c., i, 475–477.
Phosphates of lime, iron, &c.—uses, ii, 447, 449, iii, 10
Phosphoric acid—digestive uses, ii, 467.
Phosphorus — medicinal uses, ii, 449; poisoning by, iii, 53, 54
Photography—horses in motion, iii, 198, 199.
Phrenic artery—formation, i, 452.
Phrenic nerve—formation, i, 390.
Phthiriasis—causes and treatment, ii, 166.
Phymosis and its treatment, ii, 80.
Physic see titles Balls, Medicines and Drugs—for special drug see its name).
Physiology—of foot for shoeing, iii, 433–438; of gestation and parturition, iii, 264–285.
Physostigma venenosum — appearance of, ii, 462.
Pia mater of brain and spine—formation, i, 386, 383.
Picræna excelsa appearance of, ii, 466.
Picturation of animals—horse markings origin, iii, 497.
Piebald horses—colour and markings, iii, 497
Pigeon-toe—causes and disqualification, i, 72, 139; ii, 347.
Pigmy horses—evolution and breeding, iii, 286, 287.
Piles—remedies for, ii, 463.
Pillar reins for broken knees, ii, 423; for fractured jaw, &c., ii, 241, 243.

Pillars of the diaphragm—position, &c., ii, 337.
Pillions in riding—early uses, iii, 542.
Pills—administration, iii, 19.
Pilocarpine—medicinal uses, ii, 473.
Pimento—medicinal uses, iii, 7, 10.
Pimples on skin, ii, 137; mange and other causes, ii, 49, 62, 63, 167.
Pink eye—a form of influenza, ii, 31.
Pins for closing wounds, ii, 417, 438.
Pipes for stable drainage, iii, 86, 329.
Pisiform of knee, ii, 143, 196, 197; muscle insertion, ii, 341.
Pit ponies—size, iii, 496.
Pitch for shoe-nails, iii, 445.
Pitch-plaster—for fractures, ii, 260, 261; for wind-galls, ii, 357; preparation, &c., iii, 4.
Pits on pressure—use of term, ii, 364.
Pitting of skin due to small pox, iii, 150.
Pityriasis and its treatment, ii, 152.
Pivot joints—form, &c., ii, 263.
Placenta formation, iii, 251, 253; removal, ii, 88; iii, 220, 270, 271.
Plain and easy snaffle—type of, iii, 358, 359.
Plans for stable structure, iii, 320–323.
Plantar arteries form, i, 453; ii, 200.
Plantar foramina of coffin-bone, ii, 200.
Plantar nerves formation, i, 493; ii, 200; division and injury, ii, 342, 397; operation, iii, 101–104.
Plantar pads—formation, &c., iii, 503, 504, 506, 508.
Plant world—parasites from, ii, 161.
Plants—as food, causing disease and poison, i, 274; iii, 102, 104; medicinal plants (illusts.), ii, 466, 470; water purification and pollution, iii, 127–129.
Plasma of blood—composition and analysis, i, 430, 431, 434, 435; air changes, i, 480; eye nourishment, ii, 105; wound-healing, ii, 405.
Plaster for stable walls, iii, 320.
Plaster of Paris—for fractures, ii, 232; preparation, &c., iii, 38.
Plasters—application and uses, iii, 42; for fractures of various bones, ii, 232, 241, 243, 247, 260, 261; for wounds, ii, 419. (See also Mustard.
Plastic inflammations of the skin, ii, 148, 149.
Platelets in blood, i, 432, 434.
Pleistocene—fossil remains of horses, iii, 511.
Plenum system of ventilation, iii, 75.
Plethora and its treatment, i, 480.
Pleura of lungs, i, 484; diseases and puncture, ii, 1, 254, 255.
Pleurisy or pleuritis and its treatment, ii, 14–17; fractured ribs complication, ii, 254, 255; mallein and mustard uses, ii, 59, iii, 6.
Pleuro-pneumonia—cause, and heart complication, i, 223, 402; use of term, ii, 1.
Pleurosthotonus tetanus form of, ii, 47.
Plexuses of nerves—formation, i, 398.
Ploughing—spraining of muscles and shoulder-slip due to, ii, 293, 380.
Plugging of iliac arteries, ii, 237; of nostrils, i, 504; of wounds, ii, 439.
Plumbism and its treatment, iii, 51.
Pneumogastric nerve—form, &c., i, 376, 377, 395, 496, ii, 458; disease, &c., i, 313, 510.
Pneumonia and its treatment, ii, 7–10, 18; gangrenous and contagious forms, ii, 32, 33; fractured ribs effect, ii, 254, 255; influence of climate, i, 222; mustard uses, iii, 6; various complications, i, 404; ii, 7, 10, 20, 24, 30, 359.
Point of the elbow fracture, ii, 245.
Point of the haunch or hip, i, 15; ii, 192; fracture, ii, 222, 224, 256, 257.
Point of the hock—conformation, i, 23, 87, ii, 362; cow-hocks and capped hock, i, 87; ii, 362; fracture, ii, 221, 261, 262; muscles insertion, ii, 344; soundness, iii, 383.
Pointing of feet—in navicular disease, ii, 392; soundness defect, iii, 387.
Points for feeling the pulse, iii, 146.
Points of a horse divisions and names, i, 2–4; compensating points, i, 101–103; various views, i, 13, 14, 21, 22.
Poisons and Poisoning
A poison—natural instinct of animals to avoid, and liability of owners, iii, 43, 56.
Common symptoms, and what to do in poisoning, iii, 43–46.
Disease causes—chemical and specific, i, 221–223; microbes, bacteria, &c., causing poison, i, 214, 227, 228; ii, 40, 42, 406, 407, 414; water, iii, 49.
Diseases due to—dysentery, i, 291; enteritis, i, 292; gastritis, i, 274, 275; paralysis, i, 420; parturient fever, ii, 68; pyæmic arthritis, ii, 287; rheumatism, ii, 20; tetanus, ii, 46, 47; tongue inflammation, i, 252.
Food and plants, iii, 46, 55, 56, 104–106; cake food, iii, 115; hay, iii, 62; Indian or dog-tooth pea, and vetches, iii, 58–60.
Forms of poisons, their treatment, and antidotes—corrosive or irritant poisons, iii, 46–54; narcotic poisons, iii, 54–60. (For special poison, see its name, as Arsenic, &c.
"Ormie" case—tongue inflammation, i, 252.
Overdose of chloral—recovery, ii, 477.
Skin—absorption of poison, &c., ii, 129–131; diseases due to, ii, 138, 139, 142, 143.
Stings of wasps and insects, iii, 61.
Urine composition, i, 345.
Vomition—difficulty in producing, i, 275; iii, 44, 45, 47, 48, 64.
Wounds—due to bacteria, &c., ii, 405, 406, 407, 414.
[See also titles Antidotes, Blood-poisoning, for special poison, see its name, as Arsenic, &c.]
Poland horses—early Scotch crosses, i, 187.
Poll, The—formation, i, 4; fracture, ii, 234, 235; muscles attached to, ii, 319.
Poll evil and its treatment, &c., ii, 470–482; drugs, iii, 2, 4; pus among muscles, ii, 421.
Pollock's obstetric forceps use, iii, 274.
"Polonius" (1031)—hackney stallion (illust.), i, 180.
Polo ponies—Arabs as, i, 204; breeding, iii, 527.
Polypus—heart affected with, i, 454; larynx, i, 507; nose, due to lymphangitis, ii, 63; examination for, iii, 371.
Polyuria and its treatment, &c., i, 346; colour of urine, i, 344; use of nut-gall, ii, 455.
Ponds as drinking water, iii, 124, 125, 126, 130, 209.
Ponies and Pony-breeding—
Distinction as class, and of breeds, and group of varieties, i, 94, 153, 154, 158, 162, 163.
Evolution influences, iii, 280, 287.
Foals—"sibling" and other breeding principles, i, 155–157, 161.
Food and rearing land, i, 155, 156; iii, 210; undesirability of grazing on common lands, i, 154, 157, 162, 163.
Founding a stud—advice on, i, 158–163, iii, 216.
Height and size restrictions, i, 94, 154, 155, 158, iii, 496.
Ponies and Pony-breeding—(*Cont.*)
History on origin and size, iii, 476, 530, 535, 536, 538, 540.
Mange and parasites on, ii, 168, 175.
Stallion (illust.), iii, 193.
Teeth formation, iii, 399, 391, 400, 402.
[For special breeds see Dartmoor, Exmoor, New Forest, Welsh, &c.]
Pons, The—of nervous system, i, 383.
Popliteal artery formation, &c., i, 453.
Popliteal nerves—formation, i, 493, 494.
Popliteus muscle form, &c., ii, 345.
Poppy-heads medicinal uses, ii, 474.
Porous bones due to disease, ii, 211, 214.
Portal vein—liver structure, i, 239.
Porte-cord in difficult parturition, iii, 276.
Porter-coloured water composition and as drink, iii, 130.
Portio dura nerve formation, i, 394.
Portland cement for stable floors, iii, 79, 326, 327.
Position for stables, iii, 316, 320.
Position of horse—influencing distribution of body-weight, i, 91, 92; soundness indications, iii, 366; standing, trotting, &c. (see Locomotion).
Position of horse in the animal world, iii, 471–484.
Positive symptoms of disease, iii, 145.
Posterior bowel—(see Rectum).
Posterior crico-arytenoid muscle—form, &c., ii, 317.
Posterior deep pectoral muscle—form, &c., ii, 327.
Posterior extremity of body, i, 15, 16, 22, 23.
Posterior gluteal nerves—formation, i, 493.
Posterior ligament and joints structure, ii, 270, 272.
Posterior palatine nerve—formation, i, 393.
Posterior presentations in foaling, iii, 276–279.
Posterior radial artery—form, i, 440.
Posterior surface of head, i, 12.
Posterior tibial artery—form, i, 453.
Posterior tibial nerve form, i, 494.
Post horses—British uses, iii, 541; Roman uses, iii, 521, 522.
Post-mortem appearances—after anthrax, ii, 42, 43; blood due to purpura, ii, 243; bone diseases, ii, 216; congestion of lungs, ii, 75; dislocation of patella, ii, 352; eye diseases, ii, 117, 119; fractured skull and sesamoid bones, ii, 234, 251; hæmoglobinuria and tissues, ii, 25; horse-sickness, ii, 57; loose cartilages in joints, ii, 274; poisoning, iii, 51, 55, 57, 105; tetanus, ii, 49; tuberculosis, ii, 51, 52.
Post-mortem examinations restrictions as to parturient fever, ii, 67, 70, 75.
Post sphincter muscle—form, &c., ii, 325.
Potash and potassium—medicinal, &c., uses, ii, 121, 448, 449, 477, 479, iii, 2, 3, 5, 6, 8—doses of various preparations, iii, 9, 10; poisoning and antidote, iii, 45, 53.
Potassio-tartrate of antimony—dose, iii, 10.
Potatoes—composition and use as food, iii, 89, 115; digestibility, iii, 91, 92, 97; disorders due to, i, 282, 287; invalid diet, iii, 27; poisonous nature, iii, 104, 115.
Poultice-boot—form, &c., iii, 30.
Poultices and Poulticing—
Application and preparation, iii, 28–31, 33, to various parts of body, iii, 31, 32.
Blood-vessels affected by, ii, 462.
Pneumonia treatment question of external applications, ii, 9.

Poultices and Poulticing—(*Cont.*)
Poisoning treatment, iii, 60.
Various diseases—cracked heels, ii, 425; enteritis, i, 294; gastritis, i, 275; hæmoglobinuria, ii, 29; intestinal obstruction, i, 297; kidney disease, i, 349; laminitis, ii, 378; laryngitis, i, 509; paralysis, i, 422, 423; parotid glands, i, 260; penis, sheath, and testicle, ii, 83, 87; pleurisy, ii, 16; strangles, ii, 41; throat, i, 256, 258; thrombosis, i, 477; udder, ii, 90, 97; urine retention, i, 352; ventral hernia, i, 345.
Poupart's ligament—formation, &c., ii, 330.
Powdered galls—medicinal uses, ii, 455.
Powders as medicine—prescriptions, iii, 16, 17; blood-fibrine powders, iii, 141; use of arsenic, dangers, ii, 453.
Power—food influence, iii, 99, 100; muscles and lever action in relation to power, i, 31–34; height influence, i, 94; loss of power *see* Paralysis.
Precipitated powders, chalk, &c—medicinal uses, ii, 488, 490; iii, 3.
Precursory symptoms of disease definition, iii, 144.
Predisposing causes of disease—classification and definition, &c., i, 214, 215; various influences, i, 215–218.
Predisposing causes of fractures, ii, 222–224.
Pregnancy—*see* title Parturition and Pregnancy.
Prehension, muscles of—description, ii, 307.
Prehistoric horses—evolution, iii, 286.
Premature births—causes and treatment, care of foals, &c., iii, 221, 222, 267–269.
Premises—disinfection after infectious diseases, iii, 154–156.
Premolar teeth—structure, iii, 494.
Premonitory symptoms of disease definition, iii, 144.
Preparation of food—*see* Food—feeding, also Invalid food.
Prepotency in breeding, need of, iii, 212.
Prepuce—*see* Sheath.
Prescriptions—*see* title Medicines and Drugs.
Present types of horses—descent and position, iii, 471–484.
Preservation of green foods—silage method, iii, 115–118.
Pressure—air, borne by horse and man, i, 488; bandaging care, iii, 36; cause of disease, i, 220, 311, of fractured spine, i, 235, 236; hemorrhage treatment, i, 502; "pits on pressure," use of term, ii, 364; shoes causing injuries, iii, 448, 449, 453.
Pricked ears—muscles in play, ii, 311.
Pricks—of feet, ii, 365–367, canker and sinus due to, ii, 361, 428; punctured wounds, ii, 493.
Primary adhesion method of wound-healing, ii, 494.
Primary teeth—*see* Milk teeth.
Primeval horses—*see* Fossil.
"Prince of Wales" (673)—Clydesdale breeding from, i, 191.
Private persons—position as to warranties, iii, 414–419.
Prize horses—*see* Show horses.
Probang for treatment of choking, i, 267.
Processes—of cranium and face bones, ii, 184, 185, 186; fore limb bones, ii, 103, 209; lacteal system, i, 427; nerve-fibres, i, 379; trunk articulations, ii, 203; vertebral column—spinous and transverse processes, ii, 179, 180, 181, 182.
Profile of head—conformations, i, 39–42.
Profuse staling and its treatment, i, 346; nut-gall uses, ii, 455.
Prognosis of disease definition, i, 214; skin diseases, ii, 139.
Prognostic symptoms of disease, iii, 144.
Proliferous cysts—form of, ii, 102.
Prophylaxis of disease—hygiene effect, iii, 60.
Propulsion—ventilation by, iii, 75.
Prostate gland and portion of urethra, ii, 71; enlargement, &c., i, 351, 357; use of catheter, iii, 179.
Protagon of nerve tissue, i, 387.
Proteids foods and digestive action, i, 241, 246; in body, iii, 87.
Protohippus—fossil remains and horse origin, iii, 512, 513.
Protoplasm of nervous system, i, 373, 378, 387; development of life from, iii, 479, 482, 483, 484, 500; undifferentiated—formation, iii, 479, 484, 500.
Protozoa—description and generation, ii, 101, iii, 250; disease due to, ii, 52; evolution of man from, iii, 483, 484.
Protozoon—evolution of man from, iii, 483, 484.
Protrusion of cornea, ii, 115, 116.
Proud flesh—antiseptics and drugs removing, &c., ii, 449, 485, 488; iii, 2, 8; due to bone disease, ii, 214; larynx and roaring, i, 512; sand crack, ii, 366; stone in bladder, i, 358, ulcers, ii, 427; wounds, ii, 490. (*See also* Growths.)
Provender—*see* Food.
Provender room—structure, &c., iii, 320–324, 333.
Prurigo and its treatment, ii, 149; drugs, iii, 7.
Pruritus—nature, and neurosis form, ii, 149, 150; drugs, iii, 1, 2; stamping due to, iii, 341.
Prussic acid—medicinal uses, iii, 7, 9.
Psammoma tumours in brain, i, 415.
Pseudo-farcy—horse-pox mistaken for, ii, 142.
Psoas magnus and parvus muscles—form, &c., ii, 324, 325.
Psoriasis and its treatment, ii, 152, drugs, iii, 1, hereditary influence, ii, 130, 140.
Psoroptes on skin causing mange, ii, 106.
Psorosperms infesting the skin, ii, 163.
Pterygoid bones of face, ii, 188.
Pterygoid muscle—nerve of, i, 394.
Pterygoid processes of sphenoid bone, ii, 185.
Pterygoideus internus and externus—forms of muscles, ii, 299, 310.
Pterygo-pharyngeus muscle—form, &c., ii, 315.
Ptomaine poisoning in horses, iii, 46.
Ptyalin in digestion, i, 234, 244.
Ptyalism and its treatment, i, 258.
Pubio-femoral ligament of hip-joint, ii, 275.
Pubio-femoral muscles—forms, &c., ii, 325.
Pubis—formation, ii, 192; fracture, ii, 256, 257, muscles connections, ii, 338, 341, 342.
Pudic artery—formation, i, 452.
Puffing in sale of horses—illegality, iii, 416.
Pulleys for slinging, iii, 40, 41.
Pulling up suddenly a cause of fractured ulna, ii, 245.
Pulmonary affections—apoplexy affecting heart, i, 457, confusion between congestion and inflammation, ii, 469; congestion and plethora, i, 471, ii, 5, 6, 7, ii, 470, draughts for, caution, ii, 9, drugs and mustard uses, ii, 470, 473, 474, 475, hemorrhage symptoms, ii, 10, œdema of sheath, ii, 84, sick box bedding and temperature, &c., iii, 24. (*See also* titles Asthma, Bronchitis, Lungs, Pneumonia, &c.)
Pulmonary arteries, veins, and valves—formation and uses, i, 437, 438, 442, 448, 487, obstruction of valves, i, 460, sound due to action of, i, 440.
Pulmonary heart—form, &c., i, 437.
Pulmonary plexus—formation, i, 396.
Pulse—
Description and forms in health and disease, i, 440–443, iii, 146–149, conditions causing pulselessness, i, 494.
Drugs and stimulants, ii, 460, 462.
Heart disease detection, &c., i, 454, 458, 462, 463, 464, 467, 479.
Poisoning symptoms, iii, 47, 54, 57, 64.
Symptoms in various diseases—anæmia, i, 479, blood poisoning, i, 481, bronchitis, ii, 2, congestion of lungs, ii, 5, 6, horse-sickness, ii, 58; influenza, ii, 32; pleurisy, ii, 15; rheumatism, ii, 200; thrombosis, i, 474, uterine hemorrhage, ii, 80, womb disorders, ii, 66, 68, 101.
Pamiced foot—unsoundness and warranty, iii, 422.
Pump water causing disease, iii, 130.
Pumped-out horses—treatment, ii, 61; iii, 309.
Punches, Suffolk—appearance, &c., i, 195, 198, 199, 200.
Punching for wind testing, iii, 386.
Puncture for bone disease, ii, 208, for lymphangitis, ii, 23, for pus in guttural pouches, i, 509.
Punctured lungs or chest—causes and effects, i, 493, ii, 10, 254, 255.
Punctured wounds and their treatment, ii, 493, 473.
Pupil of eye—conformation, i, 11, ii, 106, 107; diseases and examination, ii, 119, 122, 123, 124, drugs affecting, ii, 431, iii, 2, 14, soundness tests, iii, 369.
Purchase of horse—warranty and examination for soundness (*see* those titles).
Purgatives or Aperients—
Action and examples, ii, 465, 471, 491; iii, 14; drastic purgatives, ii, 495.
Foals at birth, iii, 220, 224.
Poisoning treatment, iii, 51, 52, 53; restrictions, iii, 53, 54, 59, 59, 60, 63, 64.
Preparation and prescriptions for balls and draughts, ii, 444–446, iii, 16, 18.
Purpura hæmorrhagica and its treatment, ii, 24, 25; affection of skin, ii, 136, 145, 156; diseases due to, i, 503, 507, ii, 220; drugs used, ii, 448, 451, 467, iii, 3, 6.
Purse—structure, &c., i, 17, ii, 67, 68.
Pus or Matter—
As cause of disease, i, 224.
Astringents effect on, ii, 454.
Diseases affected with—bone diseases, ii, 209, 211, bowel obstruction, i, 296, brain abscess, i, 401, coat, ii, 375, epilepsy, i, 411, epizootic lymphangitis, ii, 62, eye inflammation, ii, 115, guttural pouches, i, 504–507; fistulous withers, ii, 433, 434, joint diseases, ii, 220, 222, 227, 237, liver inflammation, i, 306, milk secretion, ii, 95, 96, nasal catarrh, i, 490, 500, poll evil, ii, 430, 431, pyæmia or blood-poisoning, i, 490, 491; quittor, ii, 372, 376, 377, roaring, i, 511; sand crack, ii, 366, skin affections, ii, 137, 147, strangles, ii, 40, 41; throat inflammation, i, 255; thrombosis, i, 476, urine composition, i, 344, 346.
Shoes causing pus in foot, iii, 453, 454.
Sinuses for escape of, ii, 428.
Wound-healing agency, ii, 496, 412.
[*See also* titles Abscesses, Fistula, Tumours.]

Pustules on skin, ii, 137, 150; dressing causing, ii, 421; horse-pox symptoms, ii, 43, 141, 142
Putrefaction —agents arresting, ii, 483, 485
Pyæmia and its causes, &c., i, 409, 481, 482, due to thrombosis and strangles, i, 477, ii, 41, to wound-poisoning, ii, 407, joints affected after, ii, 282.
Pyæmic arthritis and its treatment, ii, 287, 288, "navel ill" resulting from, ii, 280.
Pylorus and orifice of stomach, i, 234, 235, 236; action in digestion, i, 245; closure and tumours, i, 268, 276, 277
Pyramidal process of os pedis—muscles insertion, ii, 333.
Pyriformis muscle—form, &c., ii, 342
Pyro-catechin - in urine, i, 339.
Pyrogenic fever—a form of strangles, ii, 39.

Q

Quadratus femoris muscle — form, &c., ii, 342.
Quadratus lumborum muscle—form, &c., ii, 326
Quaggas — cross-breeding with mare, iii, 239; special features and origin, iii, 496, 525.
Qualified warranty—form of, iii, 406, 407.
Quarantine in infectious diseases, iii, 152.
Quarters—conformation, i, 22, 80, of croup, &c., i, 58–60; deformity due to fracture, ii, 257; eczema, ii, 148; length determination, i, 97, 98, spavin in straight quarters, ii, 217; soundness examination, iii, 373, 374.
Quassia—medicinal uses, ii, 466.
Quick of foot—formation, iii, 436; pricks and injuries, ii, 385, by shoeing, iii, 453
Quicksilver—medicinal uses, ii, 488.
Quidding the food—mouth and teeth troubles causing, i, 240, 330; unsoundness, iii, 422
Quiet to ride and drive—kicking due to treatment after purchase, iii, 424.
Quilled suture for wound-stitching, ii, 417, 418.
Quinidine—medicinal uses, ii, 452.
Quinine—medicinal uses, ii, 451, iii, 8, 11.
Quittor and its treatment, ii, 378–381, 435, drugs, in, 2, 4, canker and villitis due to, ii, 381, 383, pricks and wounds causing, ii, 380, 414; unsoundness and warranty, iii, 378, 422.

R

Rabies of the horse, ii, 44
Race ou face—form, &c., iii, 495, 490.
Race-horses—
Condition—use of term, ii, 445.
Condition or physic balls, ii, 446
Conformation—breast, i, 62; canon, i, 76; croup, i, 59, 60; forearm, i, 73; hindhumb, i, 83; height and chest measurements, i, 65, 90, 94; hock, i, 88; neck, i, 50; pastern, i, 80; shoulders and muscles, i, 69, thigh, i, 85.
Diseases and injuries common to, i, 210; bleeding nose and skin, i, 503; ii, 158, 159; bone disease or "sore shins", ii, 200, 210, 229; congestion of lungs, ii, 5, filled legs, ii, 364; fractures, ii, 235, 239, 249; roaring, i, 510, 511; sprains, ii, 204, 205, 354.
Evolution influences, iii, 287
Merits and training—of Arabs, i, 203, 204; of thoroughbreds, i, 107–113; iii, 304–307.
Origin of the race-horse, iii, 531
Race-horses— *Cont.*
Stables—structure, iii, 338
Water supply in America and in England, iii, 302
[See also title Thoroughbreds.]
Racemose glands—form, &c., i, 230.
Races and racing — foundation, conduct and time-tests, &c., i, 107–111; early history, iii, 522, 526, 527, 531, 539, 542, 543, 544, 546, 547, prohibition by Cromwell, iii, 545, trotting, i, 117, 118, iii, 313, 314
Racks for stables, iii, 327
Radial arteries and veins — formation, i, 447, 449
Radial ligament—sprain, ii, 294
Radial nerve—formation, i, 400.
Radial portion of flexor pedis perforans muscle, ii, 331.
Radio-carpal articulation—form, &c., ii, 271.
Radius—conformation, i, 19, 72; ii, 195, 196; fracture, ii, 246; inflammation, ii, 212; muscle connections, ii, 330, 331, 333.
Railway horse-boxes — infection and cleansing, iii, 153; structure and drawbacks, iii, 464–467.
Rain-water — composition, &c., i, 224, iii, 121, 122; filtration and storage, iii, 125, 336.
Rape-cake—composition and use, iii, 80, 114
Rape-oil—in physic balls, ii, 444.
Rarefying ostitis—form of disease, ii, 211.
Rasping—of foot, evil effects and method for shoeing, ii, 394, iii, 434, 438, 439, 441; of teeth, i, 329
Rat tails disease, ii, 148.
Rate of growth in a horse— see Growth).
Ready-made physic balls—nature of, ii, 444.
Rearing—croup muscles, &c., assisting in, i, 58; ii, 324, 325, 339, 340, 341; means of checking, iii, 158, warranty, iii, 424.
Rearing of foals— see Foals).
Recapitulation and horse-breeding, iii, 288.
Receipts for sale of horses—forms, &c., iii, 405, 426.
Recti muscles of eye, ii, 104.
Rectified spirit—dose, iii, 10.
Recto-vaginal ligament, ii, 77.
Rectum conformation, &c., i, 237, 238; ii, 74, 76; drugs destroying worms, &c., iii, 8, 12; examination for hernia, i, 320, 323, "stone", i, 363, thrombosis, i, 475, inversion, i, 301–303; nourishment per, i, 253; plugging in foals, i, 284, 285; suppositories insertion, in, 41; unloading per hand and before operations, i, 271, 281, 284, iii, 34, 35, 181, 184.
Rectus muscles — abdominis, ii, 336, capitis anticus, major and minor, ii, 321; capitis lateralis, ii, 322; capitis posticus, major and minor, ii, 320; femoris, ii, 339; parvus, ii, 340
Recurrent disease—definition, i, 213.
Recurrent nerve—formation, i, 396.
Recurrent ophthalmia and its treatment, ii, 116–118, examination for, iii, 368.
Recurrent rheumatism—treatment, ii, 21.
Red corpuscles of blood, i, 432, 433; anæmia in, i, 479, changes due to disease, i, 478, ii, 24, drugs affecting, ii, 447, 448, 449, 450.
Red oxide of mercury—uses, ii, 488.
"Red Robin"—draught stallion 1759, price, i, 188
Red worms in arteritis, i, 471.
Rediæ and alternate generation, iii, 260, 480.
Redness of eyelids—cause, ii, 114.
Redness of skin— see Erythema
Reduced iron—medicinal uses, ii, 447.
Reducible hernia—description, i, 316.
Reflex action of nervous system, i, 388, 389; muscles control, ii, 306
Reflex epilepsy—form of, i, 410, 411.
Reflex paralysis—form of, i, 421.
Refusing to go in direction desired—warranty and vice, iii, 424.
Reins—influence on carriage of neck, i, 49 see also Bearing rein
Relaxation stitches for wounds, ii, 419.
Reliance castrator use, iii, 176, 177.
Remains of horses— past types and fossils, iii, 471–474, 509–513, 517–520.
Remedies for ailments —see title Medicines and Drugs
Renal arteries and veins—formation and uses, i, 334, 335, 482
Renal calculus—in kidney, i, 370.
Renal plexus—formation, i, 377.
Repeller—used in foaling, iii, 283.
Repositories—warranty regulations, &c., iii, 416, 417.
Representations that are not warranty, iii, 407–409.
Representatives selling horses — warranty as to, iii, 414–417
Reproduction and evolution, iii, 257–261, 286, 287, alternate generation, iii, 259–261.
Reproduction Organs—Anatomy, &c. (Female)—
Changes in ovum due to impregnation, iii, 245–249, 261–264.
Development and rate of growth of embryo, iii, 249–257, 288–295.
Labia, clitoris, vulva, hymen, vagina and passage, i, 18; ii, 73–76, foaling difficulty, iii, 273.
Muscular fibres, ii, 74, 75.
Ovary and ovum, ii, 78–80.
Urinary passage and urethra, ii, 74, 75, 76.
Uterus or womb and attachments, ii, 75–78.
Reproduction Organs—Anatomy Male —
Enumeration and appearance, ii, 64, 65
Inguinal canal and gland substance, ii, 65, 66.
Penis, prepuce or "sheath", i, 18; ii, 69, 70—muscles, ii, 73.
Spermatic cord, scrotum or purse, and vesiculæ seminales, ii, 66–69.
Testicles, testis, and tunica albuginea, i, 17; ii, 64, 65, 66.
Urethra and openings, ii, 71—muscles of, ii, 72, 73.
Reproduction Organs Diseases, &c.
Castration and Ovariotomy see those titles
Catheter insertion and uses, iii, 177–180.
Covering disease, or maladie du cont, ii, 52, 80, 85.
Drugs affecting, ii, 475, 475, 478, 481.
Eruption due to variola, ii, 141.
Female—cystic ovary, ii, 102, flooding, ii, 87–90; inflammation of uterus, ii, 89–91, 97, 98, of vaginal passage, ii, 91, 92, inversion of uterus, ii, 100–102, parturient fever, &c., ii, 97–100; udder troubles, ii, 93–97; "whites" or leucorrhœa, ii, 92
Male — comparative immunity, ii, 80; penis and sheath — enclosure and inability to withdraw, ii, 80, 82, œdema or dropsy, ii, 83; paralysis and amputation of penis, ii, 85; testicles inflammation, ii, 86.
Sterility causes, iii, 220, 230.
Residual air in breathing, i, 493.
Resin—medicinal uses, ii, 474, iii, 10.
Resistance to disease — observations, ii, 443.
Resorcin—antiseptic uses, ii, 485.

Respiration or Breathing—
Act of, and description of internal and external respiration, i, 482–484; number of breaths taken by a horse, i, 494.
Air and its composition, &c., i, 487, 493; iii, 132; after respiration, i, 488, 493; iii, 76–78, 79; air-changes in the blood, i, 489–491; impure air causing disease, i, 216, 222; ventilation, i, 495–497.
Amount of air required per horse, iii, 76, 78, 79.
Conformation affecting—breast and chest, i, 62, 63, 64; forehead, i, 38; nostrils and jaw, i, 9, 41; false nostril, iii, 508.
Effects of respiration—gases, &c., i, 482, 483, 487–491; iii, 76–78, 79.
Foals at birth, iii, 220, 285; prematurely born, iii, 221.
Formation and uses of lungs, larynx, trachea, bronchi, and air-cells, i, 484–486; chest, ribs, and diaphragm, &c., i, 491–494; muscles, ii, 308; nerves, i, 383, 494; skin functions, ii, 129, 131.
Hygienic conditions necessary for, iii, 67.
Mechanism of respiration, i, 491–494
Soundness—examination of wind, iii, 385.
Water evaporation, iii, 120.

Respiratory Diseases and Influences—
Asphyxia or suffocation, i, 494.
Bleeding—internal and from nose, i, 501–503.
Broken wind as distinct from asthma, ii, 11, 12
Bronchitis and asthma, ii, 1–4, 11
Catarrh or cold, i, 497—nasal catarrh or gleet, i, 499–501
Causes and diagnosis for signs of disease, i, 216, 222, 260; iii, 146, 148, 149; for poisoning, iii, 47.
Choking due to obstruction, i, 266
Cough and high blowing, ii, 18, 19.
Drugs, ii, 459, 468–470; stimulants and soothing, &c., ii, 470–472.
Pus in guttural pouches, i, 504–507.
Symptoms in various diseases—heart, i, 450, 457, 467, hernia, i, 320, horse-sickness, ii, 56, indigestion, i, 270; influenza, ii, 32; pleurisy, ii, 14; pneumonia, ii, 8, rheumatism, ii, 20; tetanus, ii, 48, tongue inflammation, i, 253.
[See also titles Larynx, Lung diseases, Roaring, Tuberculosis.]

Restiveness—warranty as to, iii, 424.
Restraining nerves of heart, i, 441.
Restraint of horses—during medicine administration, iii, 18–22; during operations, iii, 156–160.
Rete mucosum—of skin, ii, 125, 132.
Rete testis—formation of ducts, ii, 66, 67.
Retention of urine—causes, &c., i, 350–353; withdrawal by catheter, iii, 177–180.
Retina of eye—form, &c., ii, 107.
Retractor muscles—ani, i, 238; bulbi of eye, ii, 104; costæ, ii, 324; penis, ii, 73.
Return of horses—warranty regulations, &c., iii, 406, 425, 426.
Reverting back in breeding—(see titles Back-breeding, Telegony
Rheumatism and Rheumatic Affections—
Causes and treatment of rheumatism, ii, 20, 21, of rheumatic arthritis, ii, 285, 286, of rheumatismal tetanus, ii, 47.
Diseases due to—heart, i, 461, 463; joints, ii, 280, 282, 285; skin, ii, 138, 139; wind-galls, ii, 356.
Drugs for, ii, 452, 461; iii, 2, 3—for rheumatic poison, ii, 490.
Influence of age, i, 218.
Rhododendron—poisoning by, iii, 56.
Rhomboideus muscle—form, ii, 318; nerve connected, i, 399.
Ribbed-up horse—defects, i, 65, digestion, iii, 119, show horses, iii, 311.
Ribs—conformation and bones, i, 56, 57, 61, 63–65; ii, 180, 181—composition and disease of bone, ii, 175, 213; fractures, ii, 225, 226, 229, 254 joints or articulation of, ii, 190, 206, 267; muscles and connections, i, 63; ii, 322, 323, 324, 333–335. mustard plasters over, iii, 33, 34. respiratory uses, &c., i, 491–493.
Rice—analysis as food, i, 243. iii, 89.
Rickets—fracture liability, ii, 224, phosphorus uses, ii, 490.
Ridge ventilation in stables, iii, 331.
Riding—early history on, iii, 521, 522, 528, 535, 542, 543, 547; management of horses, iii, 201, 340; warranty, iii, 417, 424 See also titles Hunters, Saddle horses
Right heart—structure, &c., i, 437.
Right portions of abdominal cavity, ii, 338.
Right surface of head—structure, i, 10.
Rigidity of body—drug producing, ii, 478.
Rigors or shivering—in blood poisoning, i, 481, bronchitis, ii, 2, catarrh, i, 498, dysentery, i, 291, enteritis, i, 293, kidney disease, i, 349, lymphangitis, ii, 22, parturient fever, ii, 68, pleurisy, ii, 14, poisoning, iii, 47, spinal meningitis, i, 418, womb inflammation, ii, 90; examination for soundness, iii, 374, heredity of, iii, 214, 215
Rigs or ridglings description of, i, 18, iii, 184, castration see that title.
Ring-bone—causes and treatment, i, 60; ii, 205, 250; ostitis form, ii, 211, hereditary, iii, 215; operation for, iii, 161; unsoundness and warranty, ii, 302; iii, 378, 422.
Rings—in bone structure, ii, 177, on hoofs, unsoundness, &c., iii, 420, 436.
Ringworm and its treatment, ii, 140, 163–166; contagious form and herpes, ii, 149; remedies, &c., ii, 484, 485, 489; iii, 5, 8
Rise—inability to, due to broken or sprained back, ii, 295.
"Rising Star"—Suffolk prize, i, 198.
River water as drinking water, iii, 121, 122, 125, 209.
Roach back—appearance, &c., i, 57, 60.
Road—accidents and first aid, ii, 427–441. British uses of horses, iii, 541, 545. Roman roads and uses of horses, iii, 526, 529.
Roan horses—colour origin, iii, 498.
Roaring and whistling—causes and treatment, i, 510–512, due to conformation, i, 41, 44, to diseases, i, 260, 306, 506, to heredity, iii, 215, to poisoning, iii, 59, high blowing distinction, ii, 19; operation for, causing laryngitis, i, 507, 509. unsoundness and warranty, ii, 302; iii, 376, 380, 423.
Rock water—analysis, iii, 122, 123.
Rocks—animal remains in, iii, 471, 472.
Rod for preventing tearing of horse clothes, iii, 342.
Rodent ulcer—form of, ii, 156.
Rodway bar-iron for shoeing, iii, 445.
Rodway iron shoe—form, &c., iii, 443.
Rokeby Fuchsia—champion Shire mare illust., i, 195.
Roman horses history, &c., iii, 525–530, 535, 546.
Roman nose appearance, i, 41.
Roman roads construction, and use of horses on, iii, 526, 529.
Roots—as food, iii, 89, 97, 115, for pregnant mares, iii, 208, sick horses, iii, 27, poultices made from, iii, 26, 27
Ropes—for dislocation treatment, ii, 352, for operations, casting, &c., iii, 49, 159, 160, 172, horses in ditches, extraction, ii, 440 tethering of travelling horses, iii, 465
Rosettes as markings, iii, 497, 498.
Roughing of shoes, iii, 451.
Rouleaux in blood, i, 455.
Round ligament of hip-joint, ii, 275.
Round worms—forms and diseases due to, ii, 102, 109, 170, 171, drugs destroying, iii, 12
"Royal Albert" 1885—pedigree, &c., i, 177.
Royal Commission on horse-breeding—disqualifying ailments, ii, 302
Royal Commissioners distribution of king's premiums for hunter breeding, i, 140, 141.
Royal cream horses—origin, &c., i, 206, 207
Royal Interest in Horse-breeding—
Clydesdales, i, 186, 187, hackney and pack horses, i, 116, 124, hunters and premiums, i, 140, 141, Shire and war horses, i, 172–175, thoroughbreds and racing, i, 110–112.
Early history on, iii, 535–541. Tudor and subsequent periods, iii, 541–547.
Rubefacients and their uses, iii, 14.
Rugæ of bladder, i, 337.
Rugs—chafing effects, ii, 432, 435, horses eating, iii, 342, 342; hot applications and poultices, ii, 10, 15, iii, 32, sick horse clothing, iii, 143.
"Ruler" 2453—Suffolk stallion illust., i, 202.
Rum pony—origin, form, &c., i, 169.
Rump bone (see Sacrum).
Run "big" and "light"—training of thoroughbreds, iii, 306
Run down—horses susceptibility, ii, 477.
Runaway horses injuries, ii, 440, warranty, iii, 424
Running horses—early uses, iii, 537, 540, 543
Running sores due to bone disease, ii, 213. See also titles Fistula, Fistulous wounds
Ruptures or Hernia—
A definition of herma and kinds of ruptures, i, 315
Bleeding nose, i, 504.
Brain blood-vessels, i, 417, 422.
Forms of hernia and treatment—exomphalus or umbilical hernia, i, 316–318, inguinal herma, bubonocele and strangulated, i, 318, 319, 322, scrotal and ventral hernia, i, 322–325, soundness examination and warranty, iii, 373, 423.
Heart rupture, i, 475.
Intestines, i, 295, colic causing, i, 282.
Ligaments, tendons, and muscles, ii, 292, 299, 354, 395. See also Sprains.)
Liver rupture, i, 309, 310.
Lungs—broken wind due to, ii, 12.
Poisoning symptoms similarity, iii, 44
Stomach, i, 277 indigestion and dilation causing, i, 270, 271, 277, vomiting due to, i, 268
Unsoundness and warranty, iii, 373, 423.
Various effects, &c.—aorta disease, i, 473, blood in urine, i, 344; enlarged groins, i, 17, inversion of bladder, i, 372, uterine hemorrhage, ii, 87
Rutherglen fairs—early history, i, 188.
Rutting—see Œstrum).
Rye and grass—as food, i, 243 iii, 89, 352, invalid diet, iii, 26, medicinal uses of ergot of rye, &c., ii, 89, 463, 475, iii, 19, 11.

S

Saccharated carbonate of lime as antidote, iii, 51.

Saccharated iron — medicinal uses, ii, 447—dose, iii, 10

Saccharine compounds as food, i, 241.

Saccharomycetes—description, ii, 161.

Sacral artery formation, i, 452.

Sacral nerves and plexus —forms, &c., i, 375–377, 1 1, 402.

Sacro coccygeal division of vertebræ, ii, 170, 180.

Sacro-iliac ligament connections, ii, 204, 338.

Sacrum conformation and bones, i, 15, 58; ii, 179, 180, 182, connection with pelvis, ii, 102, muscle connections, ii, 323, 324, 326, 349.

Saddle– diseases due to pressure, &c , i, 220, ii, 426, 432

Saddle-backed horse—appearance and defect, i, 57

Saddle galls, &c causes, i, 220, ii, 426, 432, use of bone acid, ii, 465.

Saddle holders—types, iii, 342, 333.

Saddle Horses

Ancient history, iii, 521, 522, 528, 535

Breed not distinct, except in America, i, 147.

Breeds used and merits of—Arabs, i, 203; hackneys and hacks, i, 122, 147–149. Holsteins, i, 209, 210; pack horses, i, 124, 125.

Conformation, action, &c , i, 147–149, of back, i, 55, croup, i, 59, 60, forearm, i, 73, height, i, 94, neck, i, 51, pastern, i, 80, shoulder, i, 70, thigh, i, 85, withers, i, 54.

Crossing with thoroughbred or Arab blood, i, 148, 149.

Fractured back, and navicular disease liability, ii, 235, 391.

Training, &c., iii, 291, 307–319, 312, 340

Warranty– hired horses, &c., iii, 417, 424.

[See also title Hunters.]

Saddle room– fittings, &c , iii, 331–333.

Sainfoin hay composition, iii, 110, 111.

St. Albans royal stud foundation, i, 110.

"St. Simon" –chest measurements, i, 65; illust. of, i, 1; pedigree and stock, i, 115, iii, 548.

St. Simon strain breeding prepotency, iii, 212

St. Vitus' dance and its treatment, i, 419, 431

Sale of horses see Warranty, also Examination as to soundness

Salicine as a cooling medicine, ii, 459, 452 – dose iii, 10

Salicylate of soda and sodium medicinal uses, ii, 452 , iii, 7—doses, iii, 10

Salicylic acid—medicinal uses, ii, 452; iii, 7—doses, iii, 10, for warts, ii, 143

Saline aperients and uses, ii, 449, 450, 471; for liver, i, 393, 395, 396

Saliva—action in digestion, i, 232–234, 244; drugs affecting, iii, 14 excessive secretion, i, 232, fistula of parotid duct affecting, i, 261–264, jaw, diseased or fractured, ii, 214, 239, 240; poisoning symptoms, iii, 47; stomatitis effects, ii, 49, 50, tongue inflammation, i, 252.

Salivary calculi — formation and removal, i, 261–265.

Salivary glands or ducts—description and uses, i, 7, 230–234 drugs affecting, iii, 14; fistula effects, i, 261–263. "stones" in, i, 263–265.

Salivation and its treatment, i, 258; iodism and mercurial poisoning as, ii, 469, 470

Sallanders and its causes, ii, 157, 158; remedy, ii, 464. "chestnuts" as, iii, 501; unsoundness, iii, 374.

Salt—medicinal uses of common salt, ii, 449; iii, 92; on roads, causing disease, ii, 424, water constituent, iii, 122

Salted horses — immunity from horse-sickness, ii, 59

Saltpetre –uses and dose, iii, 3, 10.

Salts in blood, i, 435; in food and digestion, i, 241, 242; in urine, i, 338, 339, 342, 353, 354, 355—medicinal uses of various drugs, ii, 448, 454, 477

Sal volatile—stimulant uses, ii, 459.

Sand for bedding, iii, 357.

Sandals used as shoes, iii, 429.

Sand crack and its treatment, ii, 365–367, iii, 436; canker and villitis due to, ii, 381, 383; shoeing precautions, iii, 455; stopping up, fraud, unsoundness and warranty, iii, 379, 410, 423.

"Sandflake"—artificial insemination, iii, 231.

Sanitas as an antiseptic , ii, 487.

Sanitation feeding and sick boxes, ii, 288, iii, 23, 24 hygienic treatment of diseased animals, iii, 140–144, rheumatism and influenza influenced by, ii, 20, 32, washing of sick horses, iii, 55. See also title Veterinary hygiene]

Santonin—dose, iii, 10.

Saphenous nerves – formation, i, 403, 404

Saponification of oils and fats in digestion, i, 242, 249

Saprophytes—water purification, iii, 127

Sarcinacoccus –formation, &c., i, 226.

Sarcolemma of muscle fibre, ii, 305.

Sarcoptes causing mange, ii, 167.

Sarcoptic mange – treatment, &c , ii, 140, 167.

Sarcous element of muscle fibrilla, ii, 305.

Sartorius muscle– form, &c., ii, 341

Savin—effect on uterus, ii, 475.

Saw-dust as bedding, iii, 24, 355.

Scabs—ringworm and mange, ii, 164, 165, 167; wound-healing process, ii, 494, 497, 457.

Scalenus muscle –form, &c , ii, 322.

Scales on skin, ii, 137, 152.

Scalpel and its uses, i, 362, 365; ii, 304, 340

Scandinavian cross of Cleveland bays, i, 127

Scaphoid bone and ligaments connection, ii, 191, 197, 278

Scapula or blade-bone form, ii, 193, iii, 477, fracture, ii, 221, 243, joint, ii, 276; muscle attachments, ii, 312, 327, 328, 329, 330, 3 3.

Scapular cartilage – formation, ii, 193.

Scapular regions – muscles of, ii, 328, 329

Scapulo-humeral joint—form, &c., ii, 279

Scapulo-humeralis gracilis muscle form, &c., ii, 329

Scapulo-ulnaris muscle—form, &c., ii, 1 1

Scarification of bowel in rectum inversion, i, 401; of limb in lymphangitis, ii, 53; of sheath, i, 451, ii, 82, 83; of tongue, i, 253; of uterus, ii, 102.

Scarlatina—disease similar to, ii, 25

Scarring under treatment method of wound-healing, ii, 494, 497.

"Sceptre" bay thoroughbred filly illust), i, 112.

Schizomycetes –description of, ii, 161.

Schlemm, canal of in eye, ii, 108.

Schleswig horses appearance, &c., i, 210.

Schwann–white substance of, i, 379.

Sciatic nerves and fibres –formation, &c , i, 370, 403

Scirrhous cord –examination for, iii, 373.

Scirrhus –a form of tuberculosis, ii, 50.

Sclerotic of eye—anatomy and examination, i, 11, ii, 104, 105, 107, 109.

Scoop for lithotripsy, i, 367, 368

Scotland—early history on horse-breeding, i, 126, 127, 164, English restrictions, i, 174 racing instituted in, i, 110; iii, 544.

Scraper for grooming, iii, 134.

Scraping in stable—vice of, iii, 342.

Scratching skin disease due to, ii, 140

Scriptural references to the use of horses, iii, 518, 516, 520, 532.

Scrofula—a form of strangles, ii, 30.

Scrotal hernia and its treatment, i, 322–324; hereditary, i, 318.

Scrotum—conformation, i, 17, ii, 67, 68; grey masses in, ii, 71; hernia and castration, i, 319, 320, 322, iii, 173, 176; muscles insertion, ii, 336, spermatic cord and testicles "not down" in, ii, 67; iii, 184.

Scurfy skin due to curry-comb, iii, 135.

Scutiform cartilage of ear, ii, 310

Scuto-auricularis externus and internus—forms of muscle, ii, 311, 312.

Sea carriage of horses –facilities, diet, &c., iii, 461–474.

Sea-weed—medicinal uses, ii, 480.

Seated shoes—form and uses, iii, 442, 448.

Sebaceous glands –of sheath, i, 18, ii, 71, of skin, ii, 126, 131.

Sebiparous glands of skin, ii, 130.

Second inter-phalangial articulation– form, &c., ii, 273.

Second phalanx bone of fore-limb—formation, ii, 199

Second thigh—conformation and bones, i, 85, ii, 202 [See also titles Fibula and Tibia.

Secretion –a cause of disease, i, 222, of fluids by skin, ii, 130, 131, of saliva in digestion, i, 232, of urine, i, 352.

Secretory nerves –description, ii, 374.

Sedative drugs –action, &c., iii, 14; gastric, ii, 465; heart, ii, 457, 461; nervous system, ii, 476, 477, 479–483.

Seeds as diet, i, 241, 242.

Seedy toe and treatment, ii, 368–371; shoeing precautions, iii, 455; unsoundness and warranty, iii, 423.

Segmentation—process in breeding, iii, 249

Self-fixing base for stall-pillars, iii, 324.

Selling of horses — guarantee as to soundness see titles Examination, Warranty.

Semen – see Seminal fluid .

Semilunar cartilages of stifle-joint, ii, 275, 276

Semilunar crest of coffin-bone, ii, 200.

Semilunar ganglion of dorsal nerve, i, 377

Semilunar valves of heart, i, 438, 448.

Semimembranosus muscle form, &c., ii, 341.

Seminal ducts—formation, &c , ii, 66, 67, 69.

Seminal fluid or semen conveyance, &c , ii, 67, 68, 69, 71, 72, 73, iii, 229, 230, 246, artificial insemination, iii, 231–234

Semiology –definition, i, 214.

Semispinalis of back and loins—form, &c., ii, 324

Semitendinosus muscle — form, &c , ii, 340.

Sensation—drugs affecting, ii, 470, iii, 4–8, 12, 14, nerves affected by fracture, ii, 232; paralysis of sensation, i, 419; ii, 237; skin powers, &c., ii, 127, 128, 156; depriving certain part of sensation—operation see Neurotomy .

Sense, organs of—fœtal formation, iii, 257; nervous system and nerves affecting, i, 373, 374, 385, 386, 391; parasites infesting, ii, 174, 175 (for special organ, see its name).

Sensibility—(see Consciousness)

Sensible perspiration—nature of, ii, 130.

Sensitive laminæ of foot, iii, 435, 436; injuries by shoeing, iii, 453, 454.

Sensory impressions of nervous system, i, 374.

Sensory nerves and fibres, i, 374, 385, 386; division by operation, iii, 161.

Septicæmia and its treatment, i, 481, 482; due to—castration, iii, 174, to hæmoglobinuria, ii, 27, to strangles, ii, 41, to wound-poisoning and microbes, ii, 407; eucalyptus for, ii, 467; heart inflammation, i, 464

Septic glossitis—distinction, ii, 43.

Septic infection and intoxication—forms and causes of disease, i, 227, 481, ii, 406.

Septic pneumonia—causes, &c., ii, 7

Septic poisoning and organisms—causes of disease, i, 219, 222, 227, 481; iii, 174; joint diseases and wound-poisoning, ii, 280, 287, 288, 400, 414, 421; ulcers, drug, ii, 421; womb inflammation and parturient fever, ii, 90, 97, 98

Septum nasi of vomer bone, ii, 188.

Septum pectiniforme of penis, ii, 70

Serous abscess—due to capped hock, ii, 362, 363, 364, to speedy cutting, ii, 401

Serous covering of uterus—form, ii, 77.

Serous fluid—in dropsy, i, 310, villitis, ii, 364, wounds, ii, 411.

Serous gland—description, i, 232.

Serratus anticus and posticus muscles—forms, ii, 323.

Serratus magnus muscle—form, &c., ii, 333; fracture affecting, ii, 255; nerve to, i, 389.

Serum in blood, i, 435; disease due to urea in, &c., ii, 27, 56, wounds, ii, 411.

Servants driving and accidents liability, iii, 418, 419; sale of horses by, and warranty, iii, 415. (See also titles Attendants, Grooms.)

Service season—number of mares, and condition of sires in, iii, 234–236; period and indications, iii, 262, 263; refusal of mares or sires, iii, 160, 235, 236 (see also titles Breeding, Sexual intercourse).

Sesamoid bones—formation, &c., i, 75, 78, 79, ii, 198, iii, 428, disease and injury, ii, 250, 397; fracture and sprain, ii, 250–252, 295; joints and ligaments, ii, 274, 278.

Setoning and setons—for bone diseases, ii, 208, 210; frog of foot, for disease, ii, 392; poll evil, ii, 432

Setting of fractures, &c., ii, 235–239; compound, ii, 233, 234, metacarpal bones, ii, 240.

Seven-year-old—teeth of, iii, 399, 400.

Sewage fungus—in water, iii, 126, 127.

Sewage gas—disease causes, ii, 78, 82.

Sewerage system—connection with stables, iii, 84, 329, 330.

Sex as cause of disease, i, 214, 218, ii, 80.

Sexual intercourse—diseases due to, ii, 53, 80, 86, 376, drugs—abuse, and affecting, i, 348, 350, ii, 80, 475, 479, iii, 7, 12, 13, 70, sterility causes, ii, 102; iii, 222, 230 (see also titles Breeding, Service season)

Shaft of long bones, ii, 177—ossification, ii, 178.

Shafts for ventilating stables, iii, 71, 330.

Shakespeare taking charge of horses, iii, 543.

Shamus-na-cappul—meaning of title, iii, 547.

Shank bone—formation, iii, 477.

Sharp withers—character of, i, 52.

Sharpening of shoes, iii, 452.

Sheath of muscle-fibre—composition, ii, 305.

Sheath of penis—conformation and ligament, i, 18, ii, 69, 70, 71, 335, diseases—enclosure and withdrawal of penis, ii, 80, 82, œdema or dropsy, ii, 83; swelling due to urine and fracture, i, 381, 553, ii, 257, washing out, ii, 82, 83, 85.

Sheep—digestive powers, &c., iii, 60, 61, 96, 97, dipping and poison effects, ii, 120, 130, iii, 48, 49, gid or rot disease, ii, 173, 174, sheep-pox, i, 223; yew poisoning, iii, 104, 105.

Sheep-dip—poison by, ii, 129, 131, iii, 48, 49.

Shelly feet and their treatment, ii, 367, 368; unsoundness, iii, 379.

Shelters for horses out to grass, iii, 95.

Shetland ponies—appearance, &c., i, 168, 234, evolution and breeding, iii, 286, 287.

Shifting-pieces in stable-stalls, iii, 324, 325.

Shin bones—diseases, ii, 209, 210, 213. (See also titles Canon, Metacarpal, Sore shins.)

Shipment of horses—facilities, diet, &c., iii, 461–464

Shire Horse Society—work of, i, 182, 184, 185.

Shire Horses

Breeding—ancestry and early history, i, 172–178; descent from war horses, i, 178–180; present breeding, &c., i, 180–182; telegony influences, iii, 241, 242.

Classification, and prices paid for, i, 172, 185.

Clydesdale crosses and resemblance, i, 186, 190, 191

Conformation—chest and shoulder, i, 65, 70; defects and "feather", i, 180–182; general appearance and action, i, 182–184.

Illustrations—mares, i, 165, iii, 268, stallions, i, 98, 266.

Suffolks compared with, i, 194, 197.

Shivering—examination for action of, iii, 374; hereditary disease, iii, 214, 215. (See also title Rigors.)

Shock as cause of disease, i, 220, 222, drugs, ii, 457, iii, 3 poison effects, iii, 46, 61, rupture effects, i, 295.

Shoes and Shoeing

Abuses—as rasping, cutting the bars, &c., results, ii, 375, 378, 404

Anatomy and physiology of the foot, iii, 433–437

Bad shoeing and injuries, iii, 446, 452–456, causing broken knees and stumbling, ii, 422; contracted feet, ii, 393, corns, ii, 375, cutting action, ii, 406; navicular disease, ii, 390, ring bone, ii, 205; side-bones, ii, 202, splints, ii, 207, thrush, ii, 373, 374.

Fitting of shoes—feet preparation, iii, 438–441, general care and methods, iii, 446–450, nails and nailing, iii, 444, 450, 451

Forms of shoes—early types, iii, 439, 441, 442, materials, modern and special types, iii, 441–446

Healthy feet—preservation, iii, 67, 68.

History of horse-shoeing, iii, 429–432.

Model of hoof showing details, ii, 401.

Pricks and wounds of feet and their treatment, ii, 375, 386, 413, 414.

Removal for examination of foot, iii, 386.

Roughing or sharpening, iii, 451

Shoes and Shoeing *Cont*

Special treatment—harness horses and hacks, iii, 312; horses at grass, iii, 139, 310; ship-board horses, iii, 464, 467; travelling horses, iii, 467; trotters, iii, 314–316.

Specially-formed shoes or treatment, iii, 441–446; for contracted and malformed feet, ii, 340, 393, 394, curb, ii, 305, defective action as cutting, &c., ii, 347, 398, 399, 400, 401, dislocation, ii, 253, division of tendons, iii, 170, fracture, ii, 252, horn tumour, ii, 374, laminitis, ii, 379, shelly feet, ii, 368, sprains, ii, 270, 275, 296, of back sinews, ii, 354, 355; villitis, ii, 364.

Shoots for hay, &c., iii, 333.

Short conformation of back, i, 54–56, neck, i, 48, 50, pasterns, i, 60.

Shortened gaits—compensating points, i, 103.

Shoulder and Shoulder-joint—

Conformation and bones, i, 12, 58, 70, 71, 182, ii, 194, 270, iii, 476, 477, defects and compensation, i, 102, length from, i, 65, 66, muscles and connections, i, 69, 70, ii, 318, 320, 328, 329, 333, 335.

Diseases, &c.—abscesses, ii, 435, 436, fistulous wound, ii, 412, 434, galls, or sore shoulders, ii, 145, 435, 436, sprain and slip, ii, 293, 350, ulcers, ii, 426

Shoulder action, i, 49, 121, 122, ii, 329.

Show "condition" meaning of term, &c., ii, 440, iii, 215, medicines used, ii, 452, 453.

Show horses—breeding advice and back breeding, iii, 205, 212, 213, 215, classification at shows, i, 166, 170, defective action in ring, ii, 395, diseases and rejection, ii, 116, 117, preparation methods, iii, 310–311, Shire successes, i, 185, sterility of, iii, 237

Shuttle bone—see Navicular bone

Shying—due to cataract, ii, 119, warranty, iii, 424

Sialogogues and their uses, iii, 14

Sibbing in pony breeding, i, 189, 191

Sick-boxes—construction, &c., iii, 22, 24, 70, 320–324, 327, disinfection and occupation after infection, iii, 134–136, light, ventilation and temperature, iii, 142–144, 154.

Sick horses—first aid, ii, 447, 448, food and forcible administration, iii, 140–142, 551, isolation, air, &c. need, &c., iii, 134–144, transit by land, iii, 464, warranty and hiring liability, iii, 418. (See also Invalid food, Sick-boxes, Nursing.)

Sick-nursing—(see Nursing.)

Sickening for something—symptoms of disease, iii, 114.

Sickle hocks—causes, &c., i, 109, 110, ii, 361

Side-bones—causes, &c., i, 219, ii, 201, iii, 437, hereditary, iii, 215, operation and firing, iii, 161, 167, warranty and unsoundness, iii, 381, 422.

Side-line used in operations, iii, 150.

Side-rod—use in stable vices, iii, 342.

Sides, "near" and "off"—meaning of terms, i, 1.

Sides of body—poulticing, &c., iii, 32, 33.

Sieve bone—form, &c., ii, 186.

Sight—see titles Eye Diseases, Eyelid Diseases, Eyes and Eyelids.

Signs of disease—(see Disease

Silage—preparation, kinds, and uses as food, iii, 80, 115–119.

Silk, &c., for castration and operations, iii, 163, 164, 175, 182, for wound stitching, ii, 411, 416.

Silky hair on legs—see Feather.

Silver medicinal uses, ii, 454, 457, poisoning by, ii, 47

Simple fracture—form, &c., ii, 221, 225, 227
Simple ophthalmia and its treatment, ii, 114.
Simple sutures for wound-stitching, ii, 410
Simple ulcer form and treatment, ii, 426, 427.
Sinews, back—sprain or breakdown, ii, 134
Singeing methods, iii, 137, 360
Single-hoofed animals—foot formation, iii, 477.
Sinking of haunch bones—causes, &c., i, 15
Sinuses fistulous wounds and withers, ii, 428, 432, 433; frontal bones, ii, 180, plugging, ii, 434; poll evil, ii, 430, 431; quittor of foot, ii, 378, 379, 380.
"Sir George" pony stallion, breeding, &c., i, 158, 170, illust., iii, 143
"Sir Horace"—pony stallion, price, &c., i, 170.
Sires—see Stallions.
Sites—for stables, iii, 60, 70, 206, 207, 319, 320
Six-year-old—teeth of, iii, 399
Size of horses—characteristics and history of the horse, iii, 496, 530; climatic influences, iii, 530, 535, 546, 548. See also title Height.
Skeleton—appearance and bones of horse and man, ii, 176, 178, iii, 485–490; fossil remains and horse origin, iii, 511–513; growth of fœtus, ii, 178.
Skewbald horses—colour, iii, 498.
Skewers—for accidents, ii, 438, 439; for hernia, i, 518.
Skin—
As external covering of body, ii, 124.
Bare patches—formation, iii, 504, 506.
Blistering and firing, iii, 38–40, 167.
Castration after treatment, iii, 180
Cuticle or epidermis, and cutis or derma, ii, 124–126
Formation of hair, horn, chestnuts, &c., ii, 131–133, iii, 504, 506.
Glands—fat-forming and sweat glands, and hair follicles, ii, 125–127, 131.
Glossy skin—abuse of drugs for, i, 348, 349, ii, 143, 474, drugs producing, ii, 446, 453, 474, 491.
Grooming, washing, and keeping healthy, iii, 62, 69, 134–137
Injections under—see Subcutaneous injections.
Markings—origin and forms of stripes, &c., iii, 497–500
Nerves and sensibility of skin, i, 385; ii, 124, 125, 126, 127, 128
Parasites infesting, ii, 163, 166–168; iii, 103; drugs destroying, iii, 7, 8.
Poisoning through, iii, 45, 69.
Poulticing precautions, iii, 31
Soundness—inspection for, iii, 374
Uses—as protective covering and as organ of touch, ii, 127, for absorption and secretion of fluids, &c., ii, 128–131, respiratory uses and summary, ii, 131.
Water evaporation, &c., iii, 120, 123.
[See also titles Staring coat, Sweating.]
Skin Diseases, &c.—
Classification and general observations and signs, ii, 134, 135, iii, 145, 150, 152.
Diagnosis and description of various eruptions, ii, 136–138, iii, 150
Drugs, lotions, &c., ii, 472, 473—abuse causing disease, i, 347, 349, ii, 143, 474, alteratives and astringents, ii, 453, 454, 456, 457, antiseptics, ii, 429, 473, various drugs for eruptions, &c., ii, 426, 429, 490, iii, 1, 2, 3, 5, 7, 8.
Skin Diseases, &c.—*Cont.*
Eruptions and discharges due to disease—bleeding and hemorrhage, i, 501; ii, 24, 25, 150, 158, covering disease, ii, 53, 82; epizootic lymphangitis, ii, 60–63; fistula, ii, 429; glanders and farcy, ii, 30, 37, horse-pox or variola, ii, 43, 140–142, infectious diseases, iii, 150; lymphangitis fluid, ii, 22, 23; stomatitis pustulosa, ii, 49, swelling of capped knee, ii, 361.
Eruptions due to insects, blood-poison, &c., ii, 142
Eye—growths—congenital formations, &c., ii, 116.
General causes and treatment, ii, 138–140.
Grooming causing injuries, iii, 135.
Hypertrophies—warts—and atrophies senile decay, ii, 154, 155
Infectious diseases—signs and list, iii, 150, 152
Inflammations—bullous, ii, 140, catarrhal, ii, 146–148, local, ii, 143–146, plastic, ii, 148, 149; squamous, ii, 152–154; suppurative, ii, 150, 151.
Inspection for disease, iii, 374.
Mallenders and sallanders on legs, ii, 157.
New formations—cancer, &c., ii, 156.
Not attended with eruption—diagnosis, ii, 136
Parasitic diseases and causes, ii, 140, 163, 166–168; drugs, iii, 7, 8.
Sensibility of skin—neurosis and itching affecting, ii, 156
Urine and diabetes affected by activity of skin, i, 337, 340, 347
Washing as curative agent, iii, 35.
[For special skin disease see its title, as Eczema, Herpes, &c.]
Skull and bones classification, ii, 183; cranium formation, ii, 183–189, iii, 442–494, fracture, ii, 234, 235; muscle connections, ii, 314, 321, views of, i, 35, ii, 184, 185, 187.
Slack in the loin appearance, i, 57, 65.
Slaughter of horses—ancient law on, iii, 541, 542, 546, diseased and infectious ailments, ii, 63, 64, iii, 153.
Sleep—drugs inducing, ii, 476, 478; iii, 3, 5, 14, poisoning effects, iii, 54; prematurely-born foals, iii, 221.
Sleepy staggers and its treatment, i, 268, 269, 270, 406, 407
Slings and slinging—directions and materials, iii, 99, 41, for capped and broken knees, ii, 361, 443, dislocation of patella, ii, 353, fractures, ii, 231, 246, 247–249, 250, 255, 256, 258, 260, 261, joint synovitis, ii, 253, laminitis, ii, 378, sprains, ii, 297, 298; testicle, ii, 270, 271.
Slipping—shoeing precautions in winter, iii, 451.
Slipping the foal—causes and treatment, iii, 267–269
Sloping conformation—of croup, i, 58; pasterns, i, 80; shoulders, i, 69, 70.
Sloughing—of bone due to disease, &c., ii, 210, 213, 249, 253, 380; formation of sinus, ii, 428; food causing, iii, 103; hoof due to neurectomy, iii, 165, 166; poisoning effect, iii, 47, 48; skin sloughing, i, 249; ii, 25, 232, 233, 438; udder, ii, 265, 66; ulcers and abscesses, i, 502; ii, 421; unsoundness due to, iii, 372.
Small heads conformation, i, 38.
Small hyo-glossus muscle of tongue—horn, &c., ii, 314.
Small intestine—description and uses, i, 235–237.
Small-pox signs of, iii, 150.
Small stables—plans, &c., iii, 322.
Smashed bone—form of fracture, ii, 221
Smegma in sheath, ii, 74
Smell—nerves of, i, 385, 391, 484; ii, 188, test of water and air, iii, 131, 133.
Smithfield horse sales—history, iii 539
Smooth calculi in bladder, i, 350.
Smoothing-iron for pneumonia, ii, 10.
Snaffles—types of, iii, 309, 358, 359.
Snake-bites—causing poisoned wounds, ii, 414, 415.
Sneezing—due to catarrh, i, 462.
"Snorer" pony mare, price, &c., i, 171.
Snorting—due to indigestion, i, 270.
Snow—causing cracked heels, ii, 424; skin diseases, ii, 144
Soap medicinal uses, ii, 474; skin eruptions due to, ii, 142.
Soap liniment for water tests, iii, 131.
Society of Improvers, Edinburgh—work of, i, 166.
Soda and sodium—medicinal uses, ii, 445–450, 452, 477; iii, 2, 6 doses, iii, 9, 10, 11; poisoning and antidote, iii, 45, 53; sulpho-carbolates as antiseptics, ii, 435.
Soft bones—causes, &c., ii, 214–216; drug for, ii, 490.
Soft food—for horses in training, iii, 303.
Soft palate—formation, i, 7.
Soft soap—causing skin eruption, ii, 142; in physic balls, ii, 444, iii, 15, 16; washing of skin diseases, iii, 35.
Soft warts—treatment, &c., ii, 155.
Soft waters analysis, &c., iii, 122, 123.
Solar ganglion of dorsal nerve, i, 377.
Solar plexus beneath aorta, i, 377.
Sole of foot—anatomy and preparation for shoeing, ii, 434, 440, 441, pared-out sole, ii, 441, canker and quittor, ii, 361, "drop" causes, ii, 377; pricks and wounds to, ii, 385–387; removal causing contraction, ii, 394; unsoundness, iii, 381, 382.
Soleus muscle—form, &c., ii, 344
Solidungula—mammals classed as, iii, 477.
Solomon—horses kept by, iii, 518, 520, 525.
Solution of arsenic—see Fowler's.
Solutions of various drugs—medicinal uses, iii, 7, doses, iii, 10.
Solvents for "stone", i, 360.
Somerset pastures—disease causes, iii, 102.
Something the matter—symptoms of disease, ii, 144.
Soot as an antidote, iii, 58.
Soothing medicines—for heart, ii, 457, 461, kidneys and bladder, ii, 474, 475; lungs and air-passages, ii, 474, 475; nervous system, ii, 476, 477.
Soporifics and their uses and action, ii, 476, 477; iii, 14.
Sore lips—causes, &c., i, 247, 248
Soreness of joints warranty, iii, 420.
Sore shins and their treatment, ii, 219, 220 form of periostitis, ii, 210, race-horse susceptibility, i, 204, ii, 209; unsoundness, iii, 376.
Sore shoulders and their treatment, ii, 435, 436.
Sore throat and its treatment, i, 254–257; due to bronchitis, ii, 4, laryngitis, i, 507, 508, strangles, ii, 40; drugs, antiseptics and electuaries for, ii, 452, 455, 485; iii, 3, 5, 6, 21; mustard and poultice uses, iii, 6, 31, 32, 33.
Sores—running, due to bone disease, ii, 213. (See also titles Fistula, Skin Diseases—eruptions.)
Sound—
Breathing—disease symptoms, ii, 2, 5, 8, 12, 14, 15
Crepitus in fracture, ii, 225, 226
Ear muscles and cartilages for transmission of, ii, 311.
Gurgling during motion—cause, ii, 71.

Sound— *Cont.*)
Heart's action in health and disease, i, 449, 454, 459, 460, 463, 465, 467, 469, 470—anæmia, i, 459, 479.
Nerves sensible to, i, 363, 387
Sound for lithotripsy, i, 368.
Soundness—ailments disqualifying, i, 414, ii, 302; iii, 140—list of diseases, iii, 420–423, 425, 426, definitions of "sound" and "unsound", iii, 419, 425; future unsoundness and law, iii, 409, 412, 420; high blowers' sound condition, ii, 19, iii, 140; sight condition, ii, 109; thoroughbreds, i, 113; training considerations, iii, 301, unnerving precautions, iii, 104, 105. See also titles Examination, Warranty.)
Soup for sick horses, &c., iii, 94, 141.
Sour silage—preparation, &c., iii, 117
South African horse sickness—causes, and modes of infection, &c., ii, 53–55; prevention, ii, 58; symptoms, forms, and treatment, ii, 55–58.
South African war—horse-disease appearance during, ii, 59.
South's rational shoe for speedy cutters, ii, 401.
Spanish-fly—poisoning by, iii, 60.
Spanish horses—history and crosses, i, 187; iii, 528, 530, 533, 534, 535, 536, 538, 546.
Spasmodic colic and treatment, i, 278–281, rupture and heart pains mistaken for, i, 295, 469; drugs, iii, 6
Spasms—air passages, drugs relieving, ii, 472; iii, 3, asphyxia, i, 495, diaphragm, i, 312, larynx, i, 507, 512, ii, 17, 18, heart and drugs, i, 469, ii, 461, 463; rabies, ii, 45 tetanus, ii, 45, 49, 47, 48, warranty as to, iii, 423.
Spavin—forms and treatment, ii, 216–218; 290, 291; curb form, ii, 300; drug for, iii, 8; firing, ii, 167, ligament affected, ii, 278; neurectomy operation, iii, 105; sprain effects, ii, 299; unsoundness and warranty, ii, 302; iii, 367, 384, 385, 420, 421, 423.
Spavin-punch for firing, iii, 167.
Special features in structure of a horse, iii, 484–497.
Special warranty—form, &c., iii, 407.
"Speciality" (1562)—Cleveland bay, pedigree and illust., i, 128, 258
Specific diseases and fevers—causes of disease, i, 214, 222, 223; ii, 471; drugs, iii, 3, 6, skin eruptions due to, ii, 140–142; ulcers infective, ii, 427.
Specific drugs used in veterinary practice, ii, 442, 490.
Specks on eye due to cataract, ii, 119, 120.
Speed and pace in locomotion, iii, 192–194, conformation affecting, i, 62, 72, 78, 85, 86; muscles in relation to, i, 31, 32, 34; qualifications and training of hackneys, Arabs, and harness horses, i, 117, 118, 201, 203; iii, 313; thoroughbreds and trotters, iii, 305, 314
Speedy cutting as defective action, ii, 400–402.
Spermatic arteries and vein—form, &c., i, 452; ii, 66, hemorrhage in castration, iii, 174
Spermatic cord—anatomy, ii, 67, enlarged glands, i, 17; hernia, &c., i, 318, 320, 321. See also Castration)
Spermatic fluid—(see Seminal fluid).
Spermatozoa—contact with ovum, iii, 248, artificial insemination, iii, 231–234
Sperm-cell impregnation of ovum, iii, 245, 246, 248, 298.
Sphenoid bone—form, ii, 185, fracture, ii, 234.
Spheno-palatine nerve—form, i, 393.
Sphincter muscles—formation, &c., i, 15, 236, 337, ii, 73, 75, paralysis, i, 410, 421; soundness, iii, 373.
Sphygmograph—for testing pulse, iii, 146, 147, 148.
Spices—for conditioning, ii, 446, inducing appetite, iii, 94.
Spinal accessory nerve origin and form, i, 376, 385, 386, 396.
Spinal Diseases and Injuries
Broken or fractured vertebræ, ii, 235–237, distinction from disease or sprain, &c., ii, 237, 298, setting difficulty, ii, 228.
Dislocation, concussion, and sprained back, i, 421, ii, 236, 237, 298
Drugs used, ii, 465, 477, 483, iii, 2, 3.
Meningitis or inflammation of membranes of cord, i, 410, cerebro-spinal form, i, 423–425.
Myelitis or inflammation of cord itself, i, 418.
Nervous diseases effects, i, 405.
Paralysis and its causes, i, 421, ii, 236, 237.
Parasites in spinal canal of ponies, ii, 175.
Poulticing the back, iii, 32.
Protection of cord from injuries, i, 379, 380.
Soft bones due to osteo-porosis, ii, 216.
Tetanus effects, ii, 47.
Spinalis colli muscle—form, ii, 319.
Spine Vertebral Column **and Back**—
Arteries and blood supply, i, 380, 440, 451, 452.
Bones vertebræ and conformation of back, i, 3, 13, 14, 15, 55–58, 380–382; ii, 179–183, compensation for defects, i, 102, spinal canal, i, 382; ii, 179.
Cord or marrow composition and functions, i, 378, 380–382, 388, 389; ii, 179.
Diseases and injuries—(see title Spinal Diseases and Injuries).
Embryo and fœtus growth, iii, 250, 255, 257.
Eruptions, &c., on back—boils and ulcers, ii, 150, 151, 426; fistulous withers, ii, 433, 434, ringworm, ii, 164.
Joints and ligaments of vertebræ, ii, 263, 279; rib connections, ii, 266, 267; stifle-joint, ii, 276, 277, trunk, ii, 263–265.
Length measurements, i, 66, 67.
Muscles and connections—back and loins, ii, 322–324, 336; fore-limbs, ii, 328, ribs, ii, 334, neck attachments, ii, 318–320.
Nerves—forms and functions, i, 380–382, 397, 398; lumbo-sacral plexus, i, 402–405; reflex movements, &c., i, 388, 389; sympathetic ganglia, i, 374, 375.
Processes of vertebræ—formation, ii, 179, 180, 181, 182; muscle connections, ii, 318, 324.
Spine of scapula bone form, ii, 193.
Spirilla of bacteria form, i, 227.
Spirits of camphor—uses, ii, 460.
Spirits of nitrous ether—uses and doses, iii, 7, 10.
Spirits as stimulants, ii, 460; in accidents, &c., ii, 430, 440
Spiroptera infesting stomach, ii, 169.
Splanchnic nerves—forms, i, 376, 377.
Spleen—nerves and arteries, i, 377, 448; skin diseases due to, ii, 139; tuberculosis affecting, ii, 51.
Splenic artery formation, i, 452
Splenic fever—see Anthrax
Splenic plexus—formation, i, 377.
Splenius muscle and connections, ii, 318, 319
Splint bones (see Metacarpal bones).
Splinters of wood in eye, ii, 111, tongue, i, 252, wounds, ii, 429, 432, 433
Splints—bone disease, ii, 295–298—drugs, iii, 5, 8, other causes and forms, i, 20, 219; ii, 209, 211, 301, operation and firing for, iii, 164, 167, unsoundness and warranty, iii, 367, 377, 412, 420.
Splints for fractures, ii, 232, 233, 247, various bones, ii, 244, 245, 247, 249, 250.
Split pasterns—form, &c., ii, 24, 25.
Split-up quarters and thigh—appearance, i, 60, 63.
Sponges—disinfection, ii, 413, feeding foals by, i, 252, water pollution, iii, 120
Spongy bones due to disease, ii, 211, 216.
Spongy tissue in bone, ii, 176, 177.
Spontaneous epilepsy form of, i, 419.
Spontaneous generation of microbes, i, 225
Spoons used as medicine measures, iii, 12.
Sporadic disease—definition, i, 213.
Sporocyst—formation of, iii, 269.
Sporozoa—forms and diseases due to, ii, 161, 169.
Sports—early history on, iii, 522, 526, 527.
Spots—on aorta, i, 472; eyes and soundness, ii, 56, 117, 119, 120, iii, 60, 370; facial "blaze", &c., iii, 405; lips and mouth, i, 247, 249, special markings, iii, 497–508. See also titles Blood-spots, Skin diseases.
Sprains—Joints, Tendons, Ligaments, and Muscles—
As cause of disease, &c., i, 22, of aneurism, i, 477, bone spavin, ii, 218, dislocation, ii, 349, joint diseases, ii, 279, 281, 282, 286; thrombosis, i, 474.
Definition, and question of sprain or strain, ii, 291, 292.
Drugs used, ii, 480, iii, 1, 3, 5, 7, 8.
Examination for soundness, iii, 380
First-aid directions, ii, 430.
General causes and symptoms, ii, 289, 290; galloping, iii, 199, hereditary, iii, 215.
Particular sprains—back sinews or "breakdown", ii, 354, check and suspensory ligaments, ii, 251, 252, 294, 295, fetlock joint, ii, 208, flexor muscles, ii, 292, 300, perforans and perforatus tendons, ii, 276, radial ligament, ii, 294, strained back, ii, 298.
Plasters or charges for, iii, 43
(See also Bog-spavin, Bowed knees, Curb.)
Sprays for nasal catarrh, i, 500
Spring hook for hobbles, iii, 190.
Spring-water—analysis, iii, 122.
Sprinter and thoroughbred condition, iii, 306.
Sprung heels in shoeing, iii, 443
Squamæ and squamous inflammations of skin, ii, 137, 152.
Squamous eczema—form of, ii, 149.
Squamous temporal bone—form, and muscles from, ii, 184, 311
Squills—medicinal uses, ii, 469, iii, 15, 17.
Stable equilibrium of a horse, i, 30.
Stablemen—apartments structure, iii, 321, 322, 323.
Stable Management—
Accidents first aid, ii, 437.
Complete supervision—importance of, iii, 339–341.
Diseases of stabled horses—bowel and liver, i, 285, 287, 308, due to damp premises, i, 1, 7, 12, 29, poll evil prevention, ii, 432
Fastening of horses, iii, 328, 405.
Hygienic treatment of coat, feet, &c., iii, 133–140.

Stable Management—*(Cont.)*
Infectious diseases disinfection and prevention, i, 292; ii, 448, iii, 3, 8, 152; horse-sickness and horse-pox, ii, 58, 142, influenza, ii, 32; nasal catarrh, i, 500, skin diseases, ii, 150, 154, 165.
Treatment of—horses in training, iii, 303; hunters after work, iii, 309, 310; pregnant mares, iii, 218, 265, 268; ship-board horses, iii, 461, 462, 463; thoroughbreds, i, 107, 109, 112, 113. (See also Training
[See also titles Food, Bedding, Grooming, Harness, Stable vices, Ventilation, Temperature.]

Stable Structure, &c.—
Choice of site and materials, iii, 69, 70, 206, 319
Coach house, tool-house, and carriage wash-stand, iii, 334, 335.
Drainage construction and systems, iii, 84–87, 326, 328–330; flushing and cleaning out, iii, 86, 87, manure and urine—effect and removal, regulations, &c., iii, 82, 83, 335, town v. country stables, iii, 82, 84, 85.
Flooring which dispenses with drainage, iii, 337.
General decoration, accommodation, and materials used, iii, 319, 320, 323.
Harness and fodder rooms, iii, 331–333.
Horses in training—accommodation, iii, 303, 304
Lighting and position of windows, iii, 70, 71.
Plans, iii, 320–323; a good stable, iii, 323; illust., iii, 324.
Special structure for cart-horses, tramway, and racing stables, iii, 330–338
Ventilation and air space—common devices and direction of air currents, iii, 71–74, 76, 326, 330, 331; artificial ventilation, iii, 74–76; contamination of air and organic impurities due to breathing, &c., iii, 76–78; cubic air-space per horse, table, &c., on, iii, 78–80, 81, drain openings, iii, 85, 86, examination of air, iii, 142, warmth v. cold in stables, iii, 76, 80, 81.
Water supply, iii, 336
Yard and latrines, &c., iii, 334, 335.
[See also titles Loose boxes, Sick boxes, Stalls.]

Stable vices and their correction, iii, 149, 341–343; soundness and warranty, iii, 367, 413, 424–426.

Stage-coaches—horses for, i, 193, 205.

Staggering—due to anthrax, ii, 42; heart stimulants for, ii, 458; hemorrhage symptoms, i, 502, poisoning causing, iii, 47.

Staggers—cause and treatment, i, 268, 270, 406

Stagnant pools—purification, iii, 127

Staining of organisms—methods, ii, 54, 60.

Stakes—wounds caused by, ii, 402, 413

Staling—(see titles Urine, also Retention of urine)

Stallions and Sires—
Breeding and origin of various breeds—ancient laws, i, 173, 174; iii, 541, 542; Cleveland bays, i, 122; Clydesdales, i, 176, 192; hackneys, i, 115, 116–119, 119, 123; harness horse, i, 152, 153; hunters, i, 108, 135, 139, 138, 139–142; Shires, i, 172–179, 185; Suffolks, i, 195; thoroughbreds, i, 100, 110, 111—present stock of thoroughbreds sources, iii, 547, 548.
Castration—(see that title).
Catheter insertion and uses, iii, 177–180
Definition of term "stallion", iii, 541
Disqualifying ailments—list of, ii, 302.
Drugs affecting generative organs, i, 348, ii, 475, 478, iii, 4, 7, 60.

Stallions and Sires—*(Cont.)*
Early mating and service limitations, &c., iii, 213–215, 234–238.
Generative organs—(see titles Reproduction organs—anatomy and diseases).
Growth of off-spring—influence, iii, 297, 298.
Hernia or rupture, i, 318, 319, 320, 323
Illustrations—Arab, ii, 412; American trotters, i, 186; Cleveland bay, i, 258; Clydesdales, i, 240, 260, ii, 326, hackneys, i, 115, 172, 190; pack horse, i, 190, pony stallions, i, 190, iii, 193. Shires, i, 92, 256, Suffolks, i, 202, thoroughbred, i, 1, 105, 112, Yorkshire coach horse, ii, 166
Indifference to mares, iii, 235, 236.
Influence of first sire on mares—opinions on telegony, iii, 239–245.
Period of puberty, iii, 262.
Pony breeding and "nibbing", i, 156, 161, crosses, i, 160, 161, 163, grazing on common lands, i, 154, 157, 162, 163, origin of famous breeds, i, 165, 170, 171, polo pony, Arab sire, i, 204.
Soundness—examination, iii, 373.
Use of artificial insemination, iii, 232.
Working in Paris, iii, 171.

Stalls in stables, &c — construction, iii, 70, 324, 325, 327, 328, 337; drainage, iii, 84, 85, pillars, iii, 324, 325, plans, iii, 320–324; railway boxes, iii, 465, ship fitments, iii, 461, 462, tying-in arrangements, iii, 328, 465.

Stamping in stables—correction, iii, 341.

Stamps on warranties, iii, 495, 426.

Standing—diseases due to, ii, 356, 364, 369, 373, 394; equilibrium and position of a horse, i, 30, 31, iii, 191, 192, soundness guide, iii, 360; loss of power (see Paralysis).

Standing leap—method, iii, 200

Standing operation for castration, iii, 176, 177.

Stands over—knee formation, i, 74

Staphyline glands—form, &c., i, 230.

Staphyline nerve—formation, i, 303

Staphylococcus formation, &c., i, 226

Staphyloma and its treatment, ii, 115, 116.

Starch—food properties and digestibility, i, 241, 242; iii, 87, 89, 90, 91, 96, use as antidote, iii, 53.

Starch bandages for fractures, ii, 250; preparation, iii, 38.

Staring coat—diseases causing, i, 293, 304, 311, 498, 499, ii, 90, iii, 145; poisoning symptoms, iii, 47; water causing, iii, 123.

Starvation a cause of disease, i, 222.

Starwort causing poisoning iii, 63.

State coach horses—description, &c., i, 177, 206, 207

Statical symptoms of disease, iii, 145

Stealing of horses—ancient law on, iii, 542.

Steam inhalation—(see Inhalation).

Steapsin—in digestion, i, 240.

Stearin—composition of, i, 242.

Steel—for horse-shoes, iii, 442.

Steel drops—medicinal uses, ii, 447

Steel sharps—for shoes, iii, 452.

Steeplechasing—training methods, iii, 201, 305, 311.

Stenson, duct of fistula of, i, 261.

Steps in walking, iii, 194, 197.

Sterility and its causes, &c., iii, 229, 230; due to cystic ovary, ii, 102; to neck of uterus, iii, 263; to obesity, iii, 216. service and sires, iii, 180, 236, 237.

Sternal articulations and cartilages, ii, 207, 334

Sterno-maxillaris muscle—form, &c., ii, 321.

Sterno-thyro-hyoideus muscle—form, &c., ii, 321

Sternum—(see Breast.

Stethoscope for heart disease detection, i, 455, 458.

Stick—causing choking, i, 265, 266; stone in bladder, i, 370, 371.

Stiffness due to glanders and farcy, ii, 30; to poll evil, ii, 443; rheumatic joints, ii, 260, sore shins, ii, 220, thrombosis and tetanus, i, 474; ii, 48, of spine, i, 418.

Stifle and joint—conformation, i, 83, 85, 90; ii, 275–277, iii, 475, 476, patella as part of, ii, 202, 321, muscles and connections, ii, 340, 341, 343, 345, soundness, iii, 382, 383, various diseases affecting, ii, 264, 285, 286, 287, 295.

Stimulants—
Accidents and exhausted horses—uses of, ii, 6, 439, 440.
Drugs to stimulate heart, ii, 457, 458–460, lungs and air-passages, ii, 470, 471, nerves, ii, 477, 478, stomach and liver, ii, 465, 468.
Invalid diet, iii, 25.
Treatment of apoplexy, i, 413, asthma, ii, 11, blood-poisoning, i, 482, colic, i, 280, 281, 284, diarrhœa, i, 289, pleurisy, ii, 16; pneumonia, ii, 9, poisoning antidotes, iii, 50, 52, 56, 57, 64; purpura hæmorrhagica, ii, 25; spasm of diaphragm, i, 313, superpurgation, i, 290.

Stings of insects, &c drugs allaying pain, iii, 7, mouth and tongue inflammation, i, 249, 250, 252, penis and sheath affections, ii, 81, 82, poisoned wounds, &c., ii, 414, 415, iii, 61.

Stitching of wounds—directions and stitches used, ii, 411, 412, 416–419; disinfection of materials, ii, 415, 419, fistula treatment, i, 262.

Stock medicines kept in studs, ii, 444, 446

Stocking of breeding stud, iii, 210–213.

"Stockwell" 1849—pedigree, i, 114.

Stomach—
Blood supply before and after meals, i, 443.
Conformation and digestive uses, i, 91, 229, 234, 235; ii, 305, food progress, &c., i, 246, 247, iii, 116, 119, gastric digestion, i, 244, 245, muscular coating, &c., i, 235, ii, 306, nerves and arteries, i, 377, 448.
Worms and parasites infesting, ii, 169–174, causing tetanus, ii, 45.
[See also title Abdomen or Belly.]

Stomach bot and its effects, ii, 169, 170.

Stomach Diseases and Disorders—
Bleeding or hæmatemesis, i, 501.
Cough due to, ii, 18; remedy, ii, 470.
Dilation and rupture, i, 270–278, indigestion causing, i, 270, 271; pasture causing, iii, 95, vomiting due to, i, 268.
Drugs and tonics, ii, 451, 457, 460, 464–468, 470, 478, iii, 5, 6, 7.
Engorgement and overloaded, i, 271; other causes and results, i, 268, 269, 270, 274, 278, 470; iii, 101, 102
Poisoning effects, iii, 44, 45, 46, 48—influence of food in stomach, iii, 49, 55, 58, post-mortem appearances, iii, 54, 55.
"Staggers", a form of indigestion, i, 268, 270, 406.
Stomatitis, or mouth inflammation, i, 249.
[See also titles Gastritis, Indigestion, Ulceration.]

Stomatitis (simple) and its treatment, i, 249

Stomatitis pustulosa contagiosa—appearance and treatment, ii, 48–50, distinction from glanders, ii, 50.

Stone in the Bladder—
Analysis and composition of calculus and urine, i, 353–356; pus, &c., in urine, i, 344, 348.
Formation and causes of stone, i, 220, 298, 354, 360–371; in mares, i, 368.
General symptoms, diagnosis and treatment, i, 356–360.
Inflammation due to, i, 349.
Internal remedies and solvents, i, 360.
Operation of lithotomy—general preparations, &c., i, 361–363; exploring the bladder, removal of stone, &c., i, 363–366.
Operation of lithotripsy or crushing, i, 366–368.
Tumour distinction, i, 357, 358.
Warranty as to, iii, 423.
Stone pipes, &c., for drains, iii, 85, 86.
Stone solvents and their uses, i, 360.
Stone walls—jumping methods, iii, 201.
Stones Bloody urine due to, i, 348; concretions not stones, i, 300; intestinal obstruction, i, 296; salivary duct, i, 263–265; fistula due to, i, 261. See also titles Stone in bladder, Calculi.
Stoneworts in water, iii, 120.
Stop-noose used in parturition, iii, 283.
Stopping of feet, iii, 68, 139.
Storax—medicinal uses, ii, 470, 471.
Stots—use of oxen and meaning of term, i, 173.
Stoves for stable heating, iii, 334.
Straight conformation—of back, i, 57; croup, i, 58; face, i, 40; neck, i, 47, 48; shoulders, i, 70.
Straight muscle of abdomen—form, &c., ii, 335, 336.
Straight muscle of thigh—form, &c., ii, 339.
Strain or sprain—definition, &c., ii, 291, 292.
Straining—causing inversion of rectum and uterus, i, 301; ii, 100; kidney disease, i, 348; rupture and hernia, i, 315, 324.
Stramonium—medicinal uses, &c., ii, 469, 470.
Strangles—
Causes, forms, and treatment, i, 224, 481, ii, 36, 39–41; infectious nature, and mallein test, ii, 39; suppression, iii, 152, 154.
Drugs used, ii, 487; iii, 3, 4, 6, 7.
General remarks, and terms used, ii, 39.
Various complications, &c.—bronchitis, ii, 2; heart, i, 461; nasal catarrh, i, 499; joint diseases, ii, 280, 282, 286; liver, i, 393; parotid glands inflammation, i, 259; pneumonia, ii, 7; purpura, ii, 24, 145; pus accumulation, i, 504, 506; rheumatism, ii, 20, roaring, i, 510, 512; throat affections and laryngitis, i, 255, 257, 507.
Warranty and unsoundness, iii, 423.
Strangulated rupture or hernia—treatment, &c., i, 316, 319–322.
Strangulation penis and sheath, ii, 83; respiration, i, 292, 494.
Strangury due to use of cantharides, ii, 475.
Strapping-up limbs, &c., in operations, iii, 157.
Stratified rocks animal remains in, iii, 472.
Straw—as food, composition, &c., iii, 89, 96, 97, 99, 112, 354; for bedding and horses eating, iii, 24, 138, 130, 265, 354, 355; wisps for grooming, iii, 134.
Stream water causing disease, &c., iii, 125, 127.
Streptococci as cause of disease, i, 224, 226; ii, 40.
Striated and non-striated muscle—description of, ii, 305, 306.
Stringhalt and its treatment, i, 411, ii, 395; hereditary, iii, 215; unsoundness, examination, and warranty, iii, 367, 374, 423.
Stripes as skin markings, iii, 497–500; asses and zebras distinction, iii, 496.
Strokes due to paralysis, i, 420.
Strongylus armatus and tetracanthus—diseases due to, i, 471, 477, 479; ii, 171, 172, 174.
Strongylus axei in stomach, ii, 169.
Strophanthus—medicinal uses, ii, 451, 461.
"Stroxton Tom" 15871 bay horse (illust.), i, 240.
Structure of a horse—(see Conformation).
Structures—alteration and ossification, warranty as to, iii, 419, 422, 425.
Strychnia—medicinal uses, ii, 475, 478; iii, 10; poisoning by, iii, 57; tetanus due to, ii, 47.
Stud books or records Cleveland bays, i, 129, 130; Clydesdales, i, 186, 189; hackneys, i, 114, 115; Holsteins, i, 209; hunters, i, 135, 143; Shires, i, 182, 184; Suffolks, i, 196; Yorkshire coach horses, i, 134.
Stud for breeding—aims, needs, and foundation stock, &c., iii, 205–213; medicines, ii, 444, 446; pony-breeding, i, 158–163. (See also titles Breeding, Reproduction, Stable management.)
Stumbling—due to conformation, i, 45, 72, 81; defective action, ii, 291; navicular disease and broken knees, ii, 391, 422.
Stye in eye, ii, 112.
Stylo-glossus muscle—form, &c., ii, 314.
Stylo-hyoid muscle—form, &c., ii, 313.
Stylo-maxillaris muscle form, &c., ii, 310.
Stylo-pharyngeus muscle—form, &c., ii, 316.
Styloid processes of occiput and temporal bones, ii, 184, 185.
Stypties and their uses, ii, 456; iii, 14; in accidents, ii, 439.
Subcarpal arch of arteries, i, 450.
Subcarpal ligament of fore-limb, i, 20.
Subcutaneous injections—administration of drugs by, iii, 18, 22; drugs used, ii, 459, 480, 481, 483; in, 6, 100; mallein test, ii, 35, 37, 38, 39; poisoning by, iii, 45.
Subcutaneous thoracic nerve—formation, i, 400.
Subcutaneous tissue—condition in capped knee and hock, ii, 361, 363.
Sub-horny quittor—form, &c., ii, 379.
Subjective symptoms of disease, iii, 145.
Sublimed sulphur—medicinal uses, ii, 490; iii, 7; doses, iii, 11.
Sublingual glands formation, &c., i, 229, 231.
Sublobular veins—liver structure, i, 240.
Submaxillary glands—form, &c., i, 230, 231; enlargement due to disease, i, 490; ii, 63; pulse in, iii, 146.
Subscapularis muscle form, &c., ii, 328; nerve to, i, 399.
Subscapulo-hyoideus muscle—form, &c., ii, 321.
Subzygomatic nerve—formation, i, 394.
Suckling of foals—constipation and diarrhœa during, i, 285, 286, 287, 288, 289; difficulties due to thrush, i, 251, 252; pyæmia symptoms, ii, 287; refusal to feed foals, ii, 94; teats and udder attention, iii, 226; weaning process, iii, 225, 226; working mares during, i, 287. (See also Milk.)
Suckling teeth—(see Milk teeth).
Sudoric sweat—form of, ii, 130.
Sudorifics drugs classed as, ii, 472.
Sudoriparous glands—formation, &c., ii, 126, 127, 1.
Suffocation—due to asphyxia and laryngitis, i, 494, 507, 508; punctured lung, i, 493; tongue inflammation, i, 253.
Suffolk Horses—
As distinct breed, origin and early types, i, 194–196.
Comparison with Shires and Clydesdales, i, 177, 178, 194, 196, 197; with Schleswigs, i, 210.
Conformation, age, action, uses, i, 194, 197–200; colour, markings, and feather, i, 195, 196, 197, 199.
Crosses early, i, 195, 196; for Arabs, i, 204; harness horses, i, 153.
Illustration of stallion, i, 202.
Suffolk Stud-book Association restrictions, i, 197.
Sugar as food constituent, and digestion of, i, 242, 10, 87, 89, 96, in blood, i, 435; in urine, i, 346.
Sulky for trotter-training, iii, 314, 315.
Sulphates—medicinal uses, ii, 442, of ammonia and alumina, ii, 455, atropine, iii, 11; copper, ii, 436 iii, 2; iron, ii, 447, 456, iii, 7; magnesium, iii, 8; quinine, iii, 8; soda and sodium, ii, 449, 459 iii, 8; zinc, ii, 456, iii, 8—doses, iii, 11; use of magnesia as antidote, iii, 51.
Sulphides and sulphites medicinal uses, ii, 499.
Sulphocarbolate of sodium—medicinal uses, iii, 8.
Sulphocarbolates of soda and zinc as antiseptics, ii, 485.
Sulphur—medicinal uses, ii, 453, 490, iii, 5, 7, 8; premises disinfected by, iii, 155.
Sulphurated antimony—medicinal uses, iii, 8, 11.
Sulphurated potash—medicinal uses, ii, 490, iii, 8.
Sulphuretted hydrogen—uses, ii, 491; stable air contamination, iii, 78, 82.
Sulphuric acid—medicinal and other uses, ii, 453, 467, 468, iii 8—doses, iii, 9; poisoning and antidote uses, iii, 45, 46, 51.
Sulphuric ether—medicinal uses, iii, 8, 10.
Sulphurous acid medicinal and antiseptic uses, ii, 487, 475, 491, iii, 8—doses, iii, 11.
Sunday—warranty regulations, sale of horses, &c., iii, 414.
Sun rays—disorders due to, i, 407, 412.
Superficial ligament of hock-joint, ii, 277, 279.
Superficial muscles—appearance (illust.), ii, 310; brains of flexor muscle, ii, 344, gluteus muscle, ii, 339, pectoral muscle, ii, 327.
Superficial temporal nerve—formation, i, 394.
Superior cervical ganglion structure, i, 376.
Superior extremity of head, i, 4.
Superior maxillary bones of face, ii, 180.
Superior maxillary cranial nerves—formation, &c., i, 394.
Supernumerary teeth presence of, i, 327.
Superpurgation and its treatment, i, 289; action of mercury causing, iii, 3.
Supplemental air in breathing, i, 493.
Support in equilibrium of a horse, i, 31.
Suppositories—insertion and uses, iii, 41.
Suppression of infectious disease—(see Infectious diseases).
Suppurating corn—form, &c., ii, 375.

Suppurating lymphangitis—form of, ii, 30.
Suppuration—(see title Pus or Matter).
Suppurative inflammations of skin, ii, 150, 151.
Supra-carpal ligament—sprain, ii, 294.
Supra-condyloid fossa of bones, ii, 195, 202, 344
Supra-orbit of eye, i, 11
Supra-orbital nerve—formation, i, 393
Supra-scapular nerve—form, i, 399; shoulder slip due to injury, ii, 350.
Supraspinatus muscle—form, &c., ii, 320.
Supra-spinous ligament—trunk connection, ii, 263, 264
Surcingle for horse-training, iii, 307, 314
Surface drainage and gutters for stables, iii, 74–86, 329.
Surface fitting, &c., in shoeing, iii, 442, 443, 448.
Surfaces of head—structure of parts, i, 8–12.
Surgical instruments—(see Instruments, for special instrument see its name).
Surra parasite infesting Indian horses, ii, 174
Suspenders for slinging, iii, 40, 41.
Suspensory ligament of fore-limb—form, &c., i, 20, 75, 78, 79; ii, 109, 273; former uses and structure, iii, 491, 492; sprain of, ii, 251, 252, 295, iii, 380; unsoundness and warranty, iii, 380, 423.
Suspensory ligaments of penis and sheath—form, &c., ii, 71, 72, 335.
Suture forceps for wound-stitching, ii, 420.
Suture needles for wound-stitching, ii, 418, 419.
Sutures for wound-stitching, ii, 416–419, disinfection, ii, 415; use of pins, &c., ii, 418.
Swabs of wool for wound-dressing, ii, 415.
Swallowing—choking and prevention, i, 265, 480; muscles assisting in, ii, 313, 316, 317; various diseases affecting, i, 251, 255, 257, 260, 504, 508, ii, 44.
Swan neck—form, &c., i, 47, 48.
Sway-backed horse—causes of defect, i, 58.
Sweat glands of skin—forms and action, ii, 126, 127, 130, 131.
Sweating or Perspiration, and Patchy Sweats—
Clipping the coat for, iii, 137, 138.
Drugs producing and checking, ii, 472, 473, 485; iii, 5, 7, 13
Nervous influences, i, 389; ii, 130.
Skin as organ of secretion, ii, 130, 131.
Symptoms of diseases, &c.—anthrax, ii, 42, congested lungs, ii, 5, diabetes, i, 347, enteritis, i, 293; fractured vertebræ, ii, 236, glossanthrax, ii, 44; hernia, i, 320, indigestion, i, 270, 271, 273; inversion of uterus, ii, 101; kidney disease, i, 349, laminitis, ii, 377; laryngitis, i, 508; liver rupture, i, 310, poisoning, iii, 47, rupture of intestines, i, 295, spasm of larynx, ii, 17; tetanus, ii, 48, thrombosis, i, 474; uterine hemorrhage, ii, 88, womb inflammation, ii, 96.
Training of thoroughbreds and trotters, iii, 304–307, 316.
Urinary effects, i, 337.
Ventilation affecting, i, 497
Swedes as food, iii, 89, 115.
Sweet birch—medicinal uses, ii, 452
Sweetbread—description, &c., i, 241
Sweet silage—preparation, &c., iii, 115
Sweet spirit of nitre—dose, iii, 10.
"Sweet William"—Shire horse, price, i, 185.
Swellings—
Drugs used, ii, 440, 461, 489
Food causing, iii, 103
Fractures symptoms, ii, 225
Joint diseases, ii, 261, 282, 283, 286, 287, 291.
Male organs of reproduction, ii 81, 82, 84, 86.
Plasters or charges for reduction of, iii, 43
Sprain symptoms, ii, 291, 293, 294, 295, 296.
Tongue and palate, swollen, i, 252, 254.
Various diseases causing swellings—anthrax, ii, 42; covering disease, ii, 53; glanders and farcy, ii, 35, 36; hernia, i, 325; horse-sickness, ii, 56, influenza, ii, 32; liver, i, 314; lymphangitis and filled legs, ii, 22, 62, 364, poll evil, ii, 430, 431; purpura hæmorrhagica, ii, 24, 25, quittor, ii, 370, rheumatism, ii, 20, 21; salivary calculi, i, 264, stomatitis pustulosa, ii, 49, strangles, ii, 40
Swine fever—cause, &c., i, 223.
Swinging bars as stable fittings, iii, 337.
Symbiosis a form of parasitism, ii, 160
Symbiotic mange—symptoms, &c., ii, 167.
Symmetry of a horse, i, 28, 41, 119, 121.
Sympathetic nerves—heart influence, ii, 455, lumbar connections, i, 402; salivary uses, i, 232, 233 See also title Nervous system
Symphysis pubis of pelvis, ii, 192.
Symplepharon of eye, ii, 114.
Symptomatic epilepsy—form of, i, 410.
Symptomatic tetanus—causes, &c., ii, 45.
Symptoms of disease (see Disease).
Synarthrosis joints—form, &c., ii, 263.
Syncope—(see Collapse).
Synovia or joint-oil in joints, ii, 262; diseases due to, ii, 286, 290, 355, discharge in fracture, ii, 247
Synovial articulations of ribs, ii, 191, 266; tongue, ii, 266.
Synovial bursæ—description of, ii, 307.
Synovial membrane of joints—composition of tendons, ii, 306; diseases due to distention, &c., ii, 280, 281, 355, 356. loose cartilages, ii, 284.
Synovitis and its treatment, i, 282–284.
Syphilis and covering disease similarity, ii, 52.
Syringes and syringing antiseptics for, ii, 421; artificial insemination, iii, 231–234; mallein test, ii, 39, skin injections, iii, 21. See also title Injections)
Systemic arteries—distribution and names, i, 448–453.
Systemic heart—structure, &c., i, 438.
Systemic veins—circulation through, i, 438
Systems of feeding—(see Food).
Systems of horse-training—general methods, iii, 301–304.
Systole and systolic sound, &c., of heart—description, i, 439, 440, 459, 460; diagram, iii, 148.

T

Tactile papillæ of skin, ii, 126.
Tænia echinococcus infesting liver, &c., i, 313, 314, ii, 174.
Tænia perfoliata, plicata, and mamillana in intestines, ii, 172, 173.
Tail or coccyx—bones and structure, i, 15, ii, 132, 179, 183, 192; before birth, iii, 291, 292; examination for soundness, iii, 373, 374 muscles and connections, ii, 326, 327, 341; tetanus causing elevation, ii, 45, tying and whisking during operations, i, 366; iii, 174
Taking-off in jumping, iii, 199.
Tank in stable drainage, iii, 330.
Tannic acid and tannin—medicinal uses, ii, 455, iii, dose, iii, 11, poison antidote, iii, 51.
Tanno-gelatin—composition, ii, 454.
Tape used in poll evil, ii, 432.
Tape-worms in intestines, ii, 162, 172–174, liver infested with, i, 314, 315; drugs destroying, iii, 13; generation of, iii, 260, 261
Tapping—for colic, i, 283; for dropsy, i, 312; for liver inflammation, i, 308; for pleurisy, ii, 16, 17.
Tar—dressing for thrush, ii, 374; inhaling in horse-sickness, ii, 58, medicinal uses, ii, 471.
Tarsus—(see Hock).
Tartar emetic—dose, iii, 10
Tartrate of iron and potash—medicinal uses, ii, 447, 448
Taste—nerves of, i, 385, 391, 394; water test, iii, 131.
Tattersall's sales—warranties, &c., iii, 406, 413.
Taxis for hernia, i, 321, 323.
Tears from eye—secretion, &c., ii, 112, 113, 114, 175
Teat-sypbon—use of, ii, 96.
Teats and udder—cleansing, iii, 222, 227; development and diseases affecting, ii, 93–97; glycerine uses, iii, 4; pregnancy signs, iii, 264; sponging in "thrush", i, 251, 252; weaning effects, iii, 226.
Technical education—horse-shoeing, iii, 432. veterinary medicine, ii, 442.
Teeth—
Advent of horse dentists, i, 325, 331; "Orme" case influence, i, 325.
Age-tricks and birthdays, iii, 392, 393.
Conformation and changes due to age, i, 6, 220, 230, 326; iii, 389–392, 494; of "milk" and temporary teeth, iii, 393–396; of permanent set, iii, 396–399, after ten years, iii, 401; special features and identification uses, iii, 402–495.
Diseases and irregularities, i, 325–327; decay or caries, parrot mouth and wolves' teeth, i, 330–333, filling, i, 331; loose in sockets, ii, 216, molar teeth, special defects, i, 327–329; numerical excess and deficiency, i, 327.
Diseases due to condition of, i, 218; congestion of palate, i, 254, indigestion, i, 272; inflammation of mouth, tongue, and throat, i, 240, 252, 253, 255; nasal catarrh, i, 499.
Examination for soundness, iii, 372.
Food and parasites causing disease, iii, 103
Formation of artery and nerve supplying sensation, &c., i, 393, 394; ii, 189; of jaw-bone and muscles, ii, 186, 187, 189, 308, 309.
Fractured jaw causing displacement, &c., ii, 230–242.
History and origin of the horse—fossil teeth, &c., iii, 476, 510, 511, 512, 513.
Illusts of dentition at various ages, iii, 390, 394, 396, 400, 402.
Stable vices injuring, iii, 140.
Wear effects, iii, 399, 401, 495.
[See also Model of Teeth—separate pamphlet.]
Teeth rasps and shears—uses, &c., i, 329; ii, 242.

Telegony in breeding—opinions on effect of, iii, 239–245; evolution, &c., influences, iii, 480.

Temper and temperament—disease causes, i, 214, 217, 218; head, face, and ear guides, i, 36, 41, 42, 43; stable vices, iii, 140; training considerations, iii, 301, 304, 305

Temperature, climatic—influence on breeding and size of horses, iii, 531, 532, 535, 546, 548.

Temperature of Body—
- Causes of disease and nervous stimulus, i, 214, 216, 217, 387.
- Mud fever and the cause of inflammation, iii, 136
- Reduction—by alcohol, ii, 460; by drugs, ii, 443, 447, 450, 452; iii, 7, 8, 13; by sweating, ii, 130, 131, 472, 473
- Sick horses—regulation, iii, 142, 143.
- Symptoms in disease—blood-poisoning, i, 481; dysentery, i, 291; horse sickness, ii, 56, 57, 58; parturient fever, ii, 98; pleurisy, ii, 14; pneumonia, ii, 8; pyæmic arthritis, ii, 287; rheumatism, ii, 20, 21

Temperature of stables—influence and management, iii, 362, for bronchitis, &c., ii, 2, 3, 9, for sick-box, iii, 23, 24, for training horses, iii, 303; warmth *v.* cold in ventilation, iii, 79, 80, 81.

Temperature of water for sick animals, iii, 25.

Tempero-maxillary articulation of head, ii, 283, 286.

Temple of head—formation, i, 10.

Temporal artery of head, i, 11

Temporal bones of cranium, ii, 184, 185; joint with jaw, ii, 295, muscles, i, 38, 39; ii, 310, 311.

Temporalis muscle—form, &c., ii, 310

Temporary teeth—formation, &c., iii, 389, 390, 393–396.

Tendinous quittor—form, &c., ii, 379

Tendo Achilles—form, i, 23; fracture effects, ii, 262; thoroughpin, enlargement, ii, 357.

Tendons—
- Attachment of muscles to bones, use and structure of tendons, ii, 306; displacement of bones prevention, ii, 222, 223.
- Conformation—of abdomen and hip-joint, i, 16; ii, 275; canon and "tying-in" of tendons, i, 75, 76, 77; fore limb, knee, and arm, i, 19, 20; ii, 196, hind-limb, i, 23.
- Injuries due to broken and fractured knees, ii, 247, 422, 423; to wounds, ii, 413.
- Operation by division, iii, 165, 168–171.
- [For diseases see title Joints, Muscles, and Tendons diseases, for sprains see Sprains; for special tendon see its name.]

"Tennis Ball"—hunter (illust.), i, 214.

Tenotomy—uses and methods of operation, iii, 168–171; localities for, iii, 192.

Tensor palati muscle—action and form, ii, 188, 316

Tensor vaginæ femoris muscle—form, &c., ii, 339.

Tentaculæ hair growths, ii, 132.

Ten-year-olds teeth of, iii, 400, 401.

Teres minor and major muscles—forms, &c., ii, 328, 329, nerve to, i, 399.

Termination of disease—prognosis, i, 214.

Tertiary formation—horse history, iii, 475, 483, 484, 494, 509, 510.

Testicles—
- Anatomy and glands, &c., i, 17; ii, 65, 66, descent diagram, ii, 64; muscles insertion, ii, 330.

Testicles *Cont.*
- Castration—see that title.
- Diseases, &c.—cysts, ii, 103; inflammation, ii, 86; hernia effects, &c., i, 316, 319, 321; not "down" in scrotum, iii, 174, wasting due to drugs, ii, 475.

Testis anatomy, &c., ii, 65, 66; castration, iii, 174, 176.

Tetanic spasm of muscles—causes, &c., ii, 46, 47, 48; poisoning effects, iii, 45, 58.

Tetanus and its treatment, &c., ii, 45–48; bacillus or worm of, ii, 171, 412; drugs used, ii, 483; iii, 3, 6, 7, unsoundness and docking, iii, 373.

Tethering of travelling horses—means, &c., iii, 464–466.

Therapeutic symptoms of disease, iii, 144.

Therapeutical action of medicines, &c., ii, 443; iii, 12–14.

Thickening of membranes, &c.,—brain, i, 417; heart valves and walls, i, 459, 463, 464, 466; jugular vein, i, 475–477; lymphatic glands, ii, 23, 24; sinews, back—unsoundness and warranty, iii, 423.

Thigh and Thigh-bone—
- Conformation and defects, i, 22, 83, 85, 86; ii, 201, 202; compensating points, i, 102, 103; joint with hip, ii, 274, nerves, arteries, and muscles, i, 84, 85, 390, 398, ii, 339.
- Dressing after castration, iii, 174.
- Fracture and setting difficulty, ii, 224, 225, 229.
- Lacerated muscles causing stringhalt, ii, 395.

Thin horses—appetite, and want of flesh, iii, 94

Third phalanx bone of fore-limb, ii, 193.

Third ventricle of brain, i, 384

Thirst—as symptom of disease, ii, 2, 44; sick horse treatment, iii, 142.

Thompson's Black Horse—origin of Clydesdales, i, 190.

Thoracic aorta—formation, i, 451.

Thoracic duct of absorbent system, i, 425.

Thoracic nerve formation, i, 400.

Thorax—see Chest

Thorns—causing choking, i, 265, 266.

Thoroughbreds
- Ancient and modern types—comparison, &c., i, 107, 109
- Arabs' speed against, i, 203.
- Breeding, origin, and history, i, 107–111, 112, 113; iii, 528, 531, 538, 539, 540, 544, 547, 548, 549, 550—modern stock from three distinct sources, iii, 547, 548
- Conformation—of canon, i, 76; head and face, i, 36, 40; withers and shoulders, i, 52, 69.
- Crosses—Arab, i, 200, 203, 204, Cleveland bays, i, 127, 128, hackneys, i, 115; hunters, i, 135, 136, 138, 139, 141, 143; Percherons, i, 205, ponies, i, 157, 158, 160, 161, 162, 163, 165, saddle horses, i, 148, 149, Yorkshire coach horses, i, 133, 134
- Disqualifying ailments for sires, ii, 302.
- Illustrations, i, 1, 108, 112.
- Ring-bone and curb liability, ii, 295, 300.
- Teeth at various ages (illusts.), iii, 390, 394.
- Training methods and trials, i, 112, 113; iii, 304–307
- [See also titles Pedigrees, Race horses.]

Thoroughpin and its treatment, ii, 357–359, unsoundness and warranty, iii, 379, 420.

Thread-worms infesting the skin, ii, 163

Three-quarter shoe—form and uses, iii, 454, 456.

Three-year-olds as hunters, iii, 308; mating, iii, 214, 214, 235, 236; rate of growth, tables, &c., iii, 295–297; teeth of, iii, 396, 397

Throat—formation, i, 5; muscles, ii, 310, 312, 313; soundness, iii, 372 See also titles Neck, Larynx, Pharynx.)

Throat diseases and disorders—abscess, i, 257, inflammation of sore throat, i, 254–257, larynx diseases, i, 507–510, poulticing and mustard plasters for, iii, 31, 32, 33, symptoms of various diseases, i, 296; ii, 3, 40, 42, 43, 44 See also Roaring

Throat-strap for cribbiting, i, 414, 414.

Thrombosis—iliac, and of jugular vein, i, 473–477; fractured vertebræ confounded with, ii, 247

Thrombus—formation of, i, 473.

Throwing back in breeding—see title Back breeding

Throwing of rider by hunters training precautions, iii, 309.

Thrush—of feet, ii, 373; influence of canker and navicular disease, ii, 381, 392; of mouth, i, 249, 250, remedies for, ii, 456, 485; iii, 4, 7, soundness and warranty, iii, 382, 420.

Thymol as an antiseptic, ii, 427

Thyro-arytenoid muscle—form, &c., ii, 317.

Thyro-hyoid muscle form, &c., ii, 316.

Thyro-pharyngeus muscle—form, &c., ii, 315.

Thyroid cartilage of larynx, i, 485.

Tibia—conformation of thigh and bone, i, 23, 83, 85; ii, 202, 203; iii, 457, fracture, ii, 261; joints with hock, &c., i, 67, 88, ii, 275, 278, muscle connections, ii, 332, 340, 341, 342.

Tibial aponeurosis—muscle action, ii, 341.

Tibial artery formation, i, 453

Tibial crest formation, ii, 202.

Tibial nerves—formation, i, 404.

Tibial spine—formation, ii, 202.

Tibio-fibular articulation—form, &c., ii, 277.

Tibio-tarsal joint formation, &c., ii, 263.

Tic—nervous habit described as, i, 413.

Ticks—on skin, ii, 166.

Tidal air—in breathing, i, 470.

Tied-in hocks—curb causes, ii, 301.

Til cake—composition, iii, 114.

Tiles for stables, iii, 69, 81, 325.

Time and evolution influences, iii, 483

Time tests—in racing, i, 109, 117.

Tincture of iron—medicinal uses, ii, 447.

Tinctures of various drugs—doses, iii, 11.

Tinn, zonule of in eye, ii, 168.

Tissue respiration—form of, i, 483

Tissues—bone structure, ii, 176; 177; health and repair of tissue, iii, 66; hæmoglobinuria or azoturia results, ii, 27, 28, medicines acting on tissue change—alteratives, ii, 452–454, astringents, ii, 454 457, spasm causes, ii, 292; water as body constituent, iii, 119, 120, 124, wounds and healing, ii, 403, 407—use of cautery, iii, 166.

Tobacco—medicinal uses, ii, 481, 482.

Tobin's stable ventilation, iii, 331.

Toe, seedy—(see Seedy toe.)

Toe-clips in shoeing, iii, 449.

Toe-pieces for shoeing, iii, 444.

Toeing knife—use of, iii, 438.

Toes—ancient conformation, and classification of animals, i, 21; iii, 476, defects of in- and out turned toes, i, 74, 75; examination for soundness, iii, 378; fracture effects, ii, 252, 253; operations effects, iii, 165, 171. See also titles Feet, Hoofs.

Tongue
Conformation and bone, i, 6; ii, 185, 189; muscles and connections, ii, 312–314, 315, 316, 321; nerves, i, 386, 397.
Diseases and disorders—furred, due to liver, i, 403; inflammation of tongue, i, 252–254; spots on, i, 249; symptoms of glossanthrax, ii, 43, 44, of horse-sickness, ii, 55, of poisoning, iii, 47
False tongue in foal, iii, 251.
Injuries—first aid, ii, 438; use of alum, ii, 456, use of twitch, iii, 157.
Skin sensibility, ii, 128.
Tonics action, examples and prescriptions, iii, 14, 16, 17, 18, for blood, ii, 447, 448, heart, ii, 457, 460, nerves, ii, 477, 478, stomach and digestion, ii, 466, 467, 468.
Tool-house stable structure, iii, 334.
Toothless space in mouth—use, &c., iii, 494.
Top-line of body—i, 3; structure of neck, &c., i, 12–15.
Torsion—to arrest bleeding, ii, 409; for castration, iii, 174
Touch skin as organ of, ii, 127, 131.
Tournament horses—origin and uses, iii, 538, 539, 540, 541, 543, 545.
Tourniquet for arrest of bleeding, ii, 409, for neurectomy, iii, 162.
Towels disinfection of, ii, 415.
Town horses—Clydesdale and Suffolks merits, i, 192, 193, 194, 199, 200; diseases common to, i, 272, 296, 300
Town-stables—removal of dung, regulations, &c., iii, 82, 83, 84.
Toxic agents—poisoning effects, iii, 45, 46, 47, 54
Toxic fluid bacteria producing, i, 228.
Toxic tetanus form of, ii, 47
Trace-harness—undoing on fallen horses, ii, 441.
Trachea—(see Windpipe).
Trachelo-mastoideus muscle—form, &c., ii, 319
Tracheotomy—for laryngitis, i, 509; for poisoning, iii, 52, 59, 62.
Trails of various paces in locomotion, iii, 197.
Training and Breaking-in Horses—
General—application of whip and bit, and of system, iii, 301–303; food and water, iii, 302, 303; grooming, stabling, &c., iii, 303, 304.
Hard mouth due to training, i, 248.
Means of restraint, iii, 157, 158.
Show horses and harness horses, iii, 310–313.
Special breeds—hunters, iii, 307–310, thoroughbreds, iii, 304–307, trotters, iii, 313–316.
[See also Domestication.]
Tramway horses—amount of food per day, iii, 347, influenza or pink eye, ii, 31, poisoning by Indian pea, iii, 59, stables for, iii, 337.
Transit of horses—facilities and diet, &c., by land, iii, 464–467, by sea, iii, 468–474
Transversalis abdominis muscle—form, &c., ii, 337
Transversalis costarum muscle—form, &c., ii, 324
Transverse fracture—form, &c., ii, 221, 222; of various bones, ii, 249, 250, 254.
Transverse muscle of abdomen—form, &c., ii, 335, 337.
Transverse perinei muscle—action on urethra, ii, 72
Transverse processes of vertebræ, ii, 174, 180, 182, ligament and muscle connections, ii, 265, 324, 334.
Trapezium bone—of knee, ii, 107.
Trapezius muscle—form, &c., ii, 322
Trapezoid bone of knee, ii, 193, 197.
Traps in stable drainage, iii, 84, 85, 86, 329, 330.
Traumatic epilepsy form, i, 410, 411.
Traumatic tetanus form of, ii, 45.
Travelling of horses see Transit.
Travis—used in operations, iii, 158, 159
Treacle—in poultices, iii, 29
Trefoil—composition, &c., iii, 99, 111.
Trembling—disease symptoms, i, 480, ii, 44, 88, heart stimulants for, ii, 458, poisoning causing, iii, 47
Trepanning or Trephining fractured frontal bone, ii, 239, nasal, for catarrh, i, 500, 501.
Triachiasis—of eyelid, ii, 114.
Trials of race horses, iii, 306
Triangularis sterni muscle—form, &c., ii, 334.
Triceps extensor cubiti muscle—form, &c., ii, 340.
Trichodectes—on skin, ii, 160
Trichophyton tonsurans causing ringworm, ii, 163, 164
Tricks on teeth for age, iii, 392, 393
Tricuspid valve of heart, i, 436.
Trigeminal nerves—formation, &c., i, 392, 393
Tripping—(see titles Defective action, Stumbling
Trismus tetanus form of, ii, 47.
"Triumph II"—pack horse illust., i, 190
Trochanter (great and small)—of humerus, ii, 194.
Trochanter (major and minor)—of thigh-bone, ii, 201; fracture effects, ii, 260 muscle connections, ii, 330, 342.
Trochanteric fossa—formation, &c., ii, 201, 342, 343
Trochar—for relief of colic, i, 282, 283.
Trochlea—of thigh-bone, ii, 201.
Trochlearis—of eye, ii, 104
Trotters—descent, iii, 550; illusts., iii, 314; shoeing, iii, 457; training and general treatment, iii, 313–316, water supply, iii, 302. (See also American horses.)
Trotting—action and forms, iii, 195, 197, of Clydesdales, i, 193, hackneys, i, 116–118, 121, 122, hunters, i, 146, pack horses, i, 124, Percherons, i, 200, Shires, i, 184, show and harness horses, iii, 312, Suffolks, i, 195, 199, jumping from the trot, iii, 199, sport popularity, iii, 313, 314
Troughs cleansing precautions, iii, 209; stable fittings, iii, 327.
Trucks for transit of horses, iii, 464, 467.
True ancbylosis—form of, ii, 281.
True hock joint—formation, ii, 202, 203, 263; ligaments, ii, 277, 278; spavin of, ii, 290.
True ribs—formation of, ii, 161.
True skin—formation and inflammation, ii, 126, 131, 146.
True vertebræ of spinal column, ii, 170.
Trunk divisions and structure, i, 2, 3; ii, 178, of chest and abdomen, i, 62–66, height, &c., proportions, i, 52, 53, 90, 91; joints or articulations, ii, 263–265; muscles and connections, i, 53; ii, 326, 334; supply of blood to nerves, i, 389
Trusses for bog-spavin, ii, 291; hernia, i, 317; uterus inversion, ii, 102.
Trypanosoma equipedum causing dourine, ii, 52.
Trypsin in digestion, i, 246.
Tsetse fly causing disease, iii, 78
Tubercle bacillus causing disease, ii, 50, 160
Tubercle in bone formation, ii, 191, 194, 195
Tubercula on skin, ii, 137.
Tuberculin produced by bacteria, i, 228.
Tuberculosis—causes, appearance, and symptoms, i, 223, 224; ii, 42, 50, 52, 160, other terms used, ii, 50, 51, use of tuberculin, i, 228, various complications, i, 404; ii, 10, 139, wounds treatment, ii, 421, 422.
Tuberosities of bones—humerus, ii, 194; ischium fracture, ii, 257, tibia ligaments, ii, 277, 278.
Tubes for ventilating stables, iii, 72
Tubuli seminiferi of testicle glands, ii, 66.
Tubuli uriniferi—formation, &c., i, 334, 335.
Tucked-up appearance—a sign of disease, i, 17, 251, show horses, iii, 311.
Tumours—
Caused by disease, pressure, and worms, i, 214, 220; ii, 169, 171, by food and water, iii, 103, 124.
Distinction of stone or calculus, i, 357, 358, 363.
Forms and treatment—aneurism, i, 477; brain and cranium, i, 414, 415, eye, ii, 115, 116; horn of feet, ii, 372; larynx, i, 507, 509; sore shoulders, ii, 435, 436; spinal tumours, i, 418; stomach and intestines due to worms, &c., ii, 169, 171.
Sterility due to, iii, 229.
Symptoms or causes of disease—capped elbow and knee, ii, 350, 360, 361; dilation of stomach, i, 277; glanders and farcy, ii, 36; intestinal obstruction, i, 296, inversion of bladder, i, 372; liver and jaundice, i, 304; penis enclosure, ii, 81, paralysis, i, 420, 423; roaring, i, 511; valvular disease, i, 465; vertigo, i, 408.
Tunic of abdomen—description, ii, 335.
Tunica albuginea—form, &c., ii, 66.
Tunica fibrosa and granulosa of ovary, ii, 79
Tunica vaginalis, &c., of testis, ii, 65; castration and hernia treatment, i, 321.
Tunica vasculosa—formation, ii, 66.
Tunics of arteries—formation, i, 442
Tunics of eye form, &c., ii, 104, 105
Turbinated bones of face—forms, ii, 188.
Turmeric as aid to appetite, iii, 94.
Turnips—as food, composition, &c., iii, 89, 115, 359, disease due to frozen turnips, iii, 104, poultice uses, iii, 28, 29.
Turpentine—medicinal uses, ii, 469, 471, 474, oil of, iii, 6—doses, iii, 10; poisoning by, iii, 60
Tusks in male horses, iii, 390, 395, 396, 398, 400, 424
Tuson's physic ball formula, ii, 444.
Twins—foaling difficulty, iii, 273, 282.
Twisted snaffle—type of, iii, 358, 359.
Twisted suture for wound-stitching, ii, 417.
Twists of bowel—cause, &c., i, 297.
Twitches for operations, &c., iii, 156, 157, 166, 176
Twitching due to heart disease, i, 458.
Two or more persons conspiring to defraud in sale of a horse, iii, 411.
Two-storied stables—structure, iii, 338.
Two-year-olds—breeding and mating capacities, iii, 213, 234, 236, 262; racing prohibition, i, 107, 108, rate of growth, &c., iii, 205–207, teeth of, iii, 395, 396, 397; training—hunters, iii, 307, 308, thoroughbreds, iii, 306.
Tying-in of canon tendons and hock, i, 77, 87.
Tying of horses—during operations, iii, 157; in stables, iii, 328, in transit, iii, 465
Tympanitis causing heart rupture, i, 470.

Typhoid fever — causing congestion of lungs, ii, 5; food during, iii, 141; water as cause of, iii, 124.

U

Udder—see title Teats and udder)

Ulceration and Ulcers —
Antiseptics and drugs for, ii, 421, 448, 454, 456, 457, 464, 484, 485, 486, 484, iii, 3, 5, 8.
Forms of ulcers and general treatment, ii, 426–428; nasal formation mistaken for an ulcer, iii, 371.
Organs affected with ulceration —bladder, i, 366; bowel, i, 290; eyelids and eye, ii, 114, 115; larynx, i, 507, 509; mouth and lips, i, 248, 249, nostrils, i, 503; ii, 35, 36; skin, ii, 26, 127, 143; stomach see Gastritis; tracheal or bronchial membrane, ii, 10.
Symptoms of diseases—bone "caries", ii, 242; covering disease, ii, 53; epizootic lymphangitis, ii, 63; glanders and farcy, ii, 45, 56, 57; liver inflammation, i, 306; navicular disease, ii, 340; stomatitis pustulosa, ii, 39; strinphalt, ii, 305; vaginitis, ii, 91.

Ulna—form of bone, i, 19, 72; ii, 109; fracture, ii, 245, 246; joint, ii, 270; muscle connections, ii, 330, 331, 333

Ulnar nerve formation, i, 400; division operation, iii, 102, 164, 165.

Ulnar portion of flexor pedis perforans muscle, ii, 331.

Umbilical arteries in fœtus, iii, 256.

Umbilical cord and opening — see Navel.

Umbilical hernia and its treatment, i, 316–318.

Umbilical vesicle —formation, iii, 250.

Unciform bone of knee, ii, 103, 107.

Unconsciousness — see Consciousness.

Uncovered operation of castration, iii, 175, 176.

Underground drainage of stables, iii, 86, 229.

"Under himself behind" conformation and compensation, i, 92, 100.

"Under himself in front"—compensating points, i, 103.

Undifferentiated protoplasm—generative changes, iii, 479, 484, 509

Undulating face —appearance, i, 40.

Unguiculata—animals classed as, iii, 475.

Ungulate mammals—description, &c., iii, 475, 476; teeth, iii, 404

Uninterrupted suture for wound-stitching, ii, 416.

University instruction in veterinary medicine—remarks, ii, 442.

Unloading rectum—see Rectum.

Unnerved horses — examination for soundness, and warranty as to, iii, 377, 419, 422; operation of unnerving see Neurotomy.

Unsoundness— see titles Examination, Soundness, Warranty.

Unstable equilibrium of a horse, i, 80.

Unstitched condition due to sprain of tendons, ii, 290

Upper aspect of body—top-line, structure, i, 12–15.

Upright conformation of feet and pasterns, i, 86, 82.

Upright dislocation form, &c., ii, 349.

Urachus—formation of, iii, 251.

Urea in Blood, i, 335, 435; diseases due to, i, 480; ii, 26–29; discharge from system, i, 421, 490; sweat glands secretion, ii, 126, 130; urine constituent and "stone", i, 335, 340, 341, 342, 353.

Ureters form and uses, i, 333, 336; rupture, i, 343

Urethra and Urethral Canal
Forms and uses, i, 333, 337; female organs, ii, 74, 75, 76; male organs and muscles, ii, 71–73
Maladie du coit, or covering disease affecting, ii, 53.
Obstruction due to stone in bladder, i, 357, 359; dilating the urethra, &c., i, 362, 363–366; opening for crushing stone, i, 366–368
Urine disorders due to rupture, injury, or stone in canal, i, 343, 347, 348, 351, 353.
Use of catheter, iii, 172

Urethral tube—formation, ii, 71.

Uric acid—in blood, i, 435; in urine and "stone", i, 341, 353

Urine and Urinary Apparatus
Anatomy and functions of urinary organs, i, 333–336; female, i, 15, 73–75; male, ii, 69, 70, 71, 72; nerve centre, muscular tissue and muscles, i, 337, ii, 72, 336, 337
Colour of healthy urine, i, 342, 343, ii, 26; discoloration not a sign of disease, ii, 474
Coloured and thick urine due to disease, i, 342–346; iii, 149, 150; bloody urine, i, 347, ii, 475; dropsy, i, 313, 432; hæmoglobinuria or "azoturia", ii, 26–29; horse-sickness, ii, 57; indigestion, i, 271, 272; liver diseases, i, 303, 304, 305, 306; lymphangitis, ii, 22; poisoning, iii, 47; pneumonia, ii, 8; purpura hæmorrhagica, ii, 25; pus, i, 344, 349; wounds treated with carbolic acid, ii, 420
Composition and quantity of urine—amount per day, i, 335, iii, 83; analysis and conditions affecting, i, 337–340, 353, 354; ii, 26–31; chief constituents of urine, i, 340–342; poisonous nature, i, 335.
Discharge and retention of urine—apparatus and muscles, i, 336, 337, ii, 69, 71, 72, 336, 337; custom of horses driving, i, 351; diseases causing retention, &c., i, 350–353, ii, 29, 30, 53, 81, 82, 91, 264, 305; involuntary escape, i, 410, 421, profuse staling, i, 343, 346
Drugs affecting, ii, 475, 474—abuse of cantharides and tobacco, ii, 475, 482
Mares during "horsing"—trouble with, iii, 180
Stable air and drainage considerations, iii, 78, 82, 85.
Various disorders—colic mistaken idea, i, 278; obstruction causing rectum inversion, i, 301; skin inflammation causes, ii, 132
Withdrawal by catheter, i, 29–30, 250, iii, 177–179.
[See also titles Bladder, Cystitis, Diabetes, Hæmaturia, Kidneys, Polyuria, Staling, Stone.]

Uriniferous tubules—formation, &c., i, 34, 335.

Urticaria and its treatment ii, 145, 146 in covering disease, ii, 53; drugs for, iii, 2.

Uterine arteries—formation, i, 337

Uterine hemorrhage and its treatment, ii, 87–9

Uterus or Womb—
Anatomy, use, and attachments of, 76–78; nerves and muscles, ii, 73, 206.
Changes during gestation, iii, 252.
Diseases, &c.—hemorrhage or bleeding, ii, 87–89; inflammation or metritis, ii, 87–91, 92, 93; tumours and prolapsus, ii, 93, 126; inversion of uterus, ii, 100–102; rattinoid fever, ii, 97–100; pressure causing dropsy, i, 311; pus causes, i, 344, removal of ovaries, iii, 179, 183; sterility causes, iii, 229, 260, 263

Uterus or Womb *Cont*
Drugs affecting, ii, 458, 462, 472–474, iii, 3.
Entrance of semen and causes of impregnation, iii, 233, 240; artificial insemination, iii, 231–4.
Growth of embryo and fœtus — see Embryo
Removal of after-birth, iii, 270, 271.

V

Vaccination and vaccine—infection of cow pox, ii, 143, 144

Vachette clam for sand-crack, ii, 367

Vagina and vaginal passage — conformation ii, 75, 76; displacements, ii, 92, 93, 95; diseases affecting covering disease, ii, 53, 55; fistula, ii, 429; inflammation and contraction, ii, 90, 91, 92; irritability, i, 344; rupture, i, 372; dressing of wounds, syringing, and use of catheter, ii, 428, 431, iii, 180; removal of ovaries, iii, 181–183; semen injection, iii, 240, artificial process, iii, 231–234.

Vaginascope—use, &c., ii, 93.

Vaginitis and its treatment, ii, 91, 92

Vagus nerve—formation, &c., i, 385, 395, 396.

Value of a horse, i, 27.

Valves heart structure and sounds, i, 437–440, 470, neck and limbs, i, 447.

Valvular diseases causes and appearance, &c., i, 460, 464, 465, ii, 42, digitalis effects, ii, 461; diseases associated with, i, 303, 312, 460, ii, 5, sounds accompanying, i, 440, 470; thickening and obstruction of valves, i, 464, 465, 466

Valvulitis — a form of inflammation of heart, i, 461

Van work —horses suitable, i, 194, 199, 200, 205, 210

Vapour respiratory uses, i, 412, 431 see also title Inhalation.

Varicose veins — thrombosis causes, i, 475.

Varieties of the horse—English, i, 137–140, foreign, i, 200–210, heavy horses, i, 172–193, ponies, i, 153–170, stock for breeding, iii, 211 See also titles History of the horse, for special breed see Clydesdales, Thoroughbreds, &c.

Variola equina and its treatment, &c., ii, 140–142, medicines, ii, 443

Variolous diseases medicinal treatment, ii, 443

Variolous eruption on labia, ii, 140

Varnish on coat—injurious effect, ii, 131.

Vas deferens of testis, ii, 67, 67

Vasa recta and vasa efferentia of testicle, ii, 67.

Vascular system Bleeding nose and villus causes, i, 503; ii, 383 see also Blood vessels

Vaseline as an ointment, iii, 42

Vastus externus and internus muscles —forms, &c., ii, 40

Vegetable acids — as food, i, 241, for antiotes, iii, 52.

Veins— see title Arteries and Veins.

Velum interpositum of brain, i, 384.

Venæ cavæ—circulation through, i, 427, 428, liver structure, i, 292, foramina causes, ii, 94.

Venæ vorticosæ of eye, ii, 105.

Venesection — see Blood-letting

Venice turpentine for fractured jaw, ii, 241

Venous blood and system composition, &c., i, 434–437, hemorrhage, i, 501, pulse in disease, i, 462.

Ventilation—
Breathing process—need and regulation of ventilation, i, 495, 497.
Disease caused by defective ventilation, i, 222; ii, 24.
Sick box ventilation, iii, 23.
Stable management and structure, i, 495–497; iii, 330, 361; drains, iii, 329, 330; horses in training, iii, 503; laryngitis treatment, i, 500; plans of stables, iii, 320.
Ventral hernia and its treatment, i, 324.
Ventral laminæ formation, iii, 250.
Ventricle of larynx muscle action, ii, 317.
Ventricles of brain —conformation, i, 4.
Ventricles of heart—conformation, i, 438; dilatation sounds, i, 450; growths and rupture, i, 464, 470; valves obstruction effects, i, 466.
Veratrium —medicinal uses, ii, 470
Verdigris as an antiseptic in castration, iii, 173, 174
Vermicides and vermifuges—see Anthelmintics.
Vermin-killers—poisoning of horses by, iii, 49, 53, 57, 58.
Verrucæ—see Warts.
Vertebræ and vertebral column—(see Spine, also titles Dorsal, Lumbar, &c.).
Vertebral arteries—formation, &c., i, 389, 449.
Vertical fracture of ribs, ii, 254.
Vertigo or megrims and its treatment, i, 497–499; colic causing, i, 229; distinction from epilepsy, i, 410; symptoms of heart disease, i, 458, 464, 467; of poisoning, iii, 50; of thrombosis, i, 470; unsoundness and warranty, iii, 422.
Vesical calculi—(see title Stone in the bladder).
Vesicants in blistering, iii, 50
Vesicles—of lungs, i, 487; of ovum, ii, 79, 80; on lips, i, 247; on skin, ii, 137; symptoms of diseases, ii, 44, 53, 63, 147, 149
Vesico-vaginal fistula—form, ii, 420.
Vesico-vaginal ligament near uterus, ii, 77
Vesiculæ seminales—formation, &c., ii, 68.
Vesicular calculus—(see Stone in the bladder
Vestigial remains of horses—evolution theories, iii, 485
Vetches—as food, composition, &c., iii, 110, 111, 113, 350, 551; for indigestion and sick diet, i, 273; iii, 26; poisoning by Indian pea, iii, 58–60
Veterinary College, Royal—foundation, iii, 430.
Veterinary Hygiene and Hygienic Conditions—
Application, and general considerations, ii, 442; iii, 64–66.
Conditions of health, iii, 64, 65—ordinary conditions for maintenance, iii, 66–69.
Disease—due to bad conditions, i, 478, 480; hygienics applied to diseased animals, iii, 140–144; signs and symptoms of disease, iii, 144–152, prevention and suppression, iii, 152–156; special treatment of pneumonia and purpura hæmorrhagica, ii, 9, 25.
Examination of air, iii, 132.
Grooming, bedding, &c., or "individual hygiene", iii, 133–140; sweating, ii, 473.
[See also titles Food, Nursing, Stable management, Stable structure, Ventilation.]
Veterinary science—technical and university instruction in, ii, 442.
Vibrios a form of bacteria, i, 227.
Vices and nervous habits—ear and eye guides, i, 41, 42; forms and correction of stable vices, &c., i, 413–415; iii, 140, 341–343, 424–426; mares during "horsing", iii, 180; soundness and warranty, iii, 397, 413, 424–426.
Vicious mares—removal of ovaries, iii, 180–184
Villi—in intestines and lacteal system, i, 287, 427; of coronary cushion and horn, ii, 383; iii, 505; on human ovum, iii 251.
Villitis and its treatment, ii, 385–385.
Vinegar—dose, iii, 111; use in accidents, &c., ii, 470; as antidote, iii, 45, 52; use of vinegar of cantharides, iii, 8
Virulent diseases cause and transmission, i, 219, 223
Virus—as cause of disease, i, 221, 222, ii, 52; iii, 150, 151, 155, in wounds and ulcers, ii, 402, 403, 427; inoculation and destruction, iii, 150, 151, 155.
Vision—see titles Eye diseases, Eyes.
Vital activity—foundation and evolution, iii, 479, 484
Vital capacity in breathing, i, 493.
Vital spot arresting respiration, i, 494.
Vitality and the causes of disease, i, 216, 218, 222.
Vitelline membrane in breeding, iii, 249
Vitellus of ovum, ii, 79
Vitreous humour of the eye conformation, ii, 165, 167; diseases affecting, ii, 117, 123.
Vitriol for glossy coats, i, 248; poisoning and antidote, iii, 45, 46.
Voice—organ of, i, 484, 475
Volatile oils—food constituents, i, 243.
Voltaire on Zadig's method of observation, iii, 473–475
Volume of the head, i, 37
Voluntary muscles—description and movements, i, 33, 82; ii, 305, 306; drugs affecting, ii, 475, 478
Volvox globator in water, iii, 128, 129
Vomer—form of bone, ii, 186
Vomiting—causes, rarity, and difficulties in, i, 235, 268, 275; antidotes use and poisoning, iii, 44, 45, 47, 48, 64; due to indigestion and rupture, i, 270, 271, 278; stimulants used, ii, 479.
Vulva—conformation, i, 76, 77; ii, 74; diseases causing swelling, &c., ii, 53, 61, 98; flooding and inversion of uterus through, ii, 88, 100.

W

Walker's face cradle for fractured jaw, ii, 241.
Walking—action and steps, iii, 192, 194, 197; of Clydesdales, i, 102, 103; hackneys, i, 123, hunters, i, 146, Shires, i, 184, Suffolks, i, 199, equilibrium of a horse, i, 30, 31, 92; iii, 192.
Wall of foot—anatomy, &c., iii, 433, 434
Walls of stable—structure, &c., i, 496; iii, 323–325
Waltham royal stud foundation, i, 110.
Want a rib—appearance of horse, i, 57
War Horses—
Ancient history and uses, iii, 485, 517, 519, 520, 521, 523, 524, 525, 528, 529, 530, 531, 532, 533, 534.
British—breeding and history, i, 172–178; iii, 535, 536, 537, 542, 545, 550, conformation and crosses, i, 124, 126, 173, descent of bays and Shires, i, 125, 126, 178, 179, 180, weight of armour, &c., i, 175.
[See also titles Cavalry, Chariots, Military horses.]
Warmth *v.* cold in stables, iii, 71, 80, 81.
Warranty of Horses—
Dealers and private persons and others special laws, iii, 414–419.
Defects that are patent, iii, 411–413, 414.
Definitions and forms used, iii, 405–407, 419, 425, 426.
Fraud in various forms, iii, 409–411
Horse not answering to warranty—course to follow, iii, 425, 426.
Lists of diseases, &c., disqualifying or constituting "unsoundness"—and what constitutes "soundness", i, 413; ii, 392; iii, 419–424, 425, 426.
Representations not amounting to warranty, iii, 407–409
Vices and other faults, iii, 424–426
[See also titles Examination for soundness, Soundness.]
Warts and their treatment, ii, 134, 135, on lips, i, 248, penis, &c., ii, 61, 62, 63; fluids and drugs destroying, ii, 143, 453, 468; iii, 13, 14, 65, 5.
Washing of horses—advisability and processes, cause of mud fever, &c., iii, 135, 137, before operations, iii, 173, 181, 182, 185, sick horses, iii, 35; strangles, iii, 154.
Washing of railway horse-boxes, iii, 154.
Washing-places, &c., in stable-yard—structure, iii, 329–324, 335, 338.
Washy horses—formation of withers, i, 55; indigestion and diarrhœa, i, 272, 287.
Wasps—stings causing inflammation and poisoning, i, 249, 250, 252; ii, 424, iii, 61.
Waste from body—action of skin and blood, ii, 131, 447, hygiene influence, iii, 66; water excreted, iii, 120
Wasting—due to arteritis, i, 471, covering disease, ii, 53, dilation of stomach and dropsy, i, 276, 411; food, iii, 102, hæmoglobinuria, ii, 30, tuberculosis, ii, 51; udder disease, ii, 95–97—iron effects, ii, 446, soundness examination, iii, 372, 373.
Water—
As drink—amount per day, and analysis, i, 241, 243, 273; iii, 120; digestive uses and before meals, iii, 115, 119, for breeding studs and mares, iii, 200, 266; restorative in accidents, &c., ii, 440; sick horses, iii, 24, 142; "sippers", i, 275, training of horses, iii, 192; travelling horses, by sea and rail, iii, 405, 407.
Body constituents and requirements, iii, 87, 119, 120, in various organs, iii, 124
Breathing process and uses, i, 491.
Causes of disease, &c., i, 216, 221, iii, 124–126; anthrax, ii, 42; colic, i, 270; dysentery, i, 261, joint inflammation, ii, 282; nettle-rash, ii, 145, 146, stone in bladder, i, 354, superpurgation, i, 289.
Composition, purity, and impurities of rain and other waters, iii, 121–123; disease influences, iii, 124–126; examination means, iii, 129–132; natural processes of purification, iii, 126–129, organisms in and hygienic destruction, i, 224; ii, 161; iii, 65
Hard water—disease influence, iii, 123, 124.
Health maintenance, iii, 66, 67
In food—percentage of, iii, 89.
Physic preparation uses, ii, 445
Poisoning by, and pollution of water, iii, 48, 209.
Rabies in horse—thirst, ii, 44.
Skin sensibility and absorption, ii, 128, 129.
Stable supply and fittings, iii, 336—pots, iii, 327, 328, 337.
Storage systems, iii, 125, 126.

Water—*Cont*
Swimming in water, &c.—diseases due to, i, 292; ii, 14, 45
Treatment of indigestion and gastritis, i, 273, 279; pneumonia, ii, 9
Urine constituent, &c., i, 337, 338, 342
Water bath—for physic, ii, 445
Water bladders—on skin, ii, 137
Water-pots—stable fittings, iii, 327, 328, 337
Water wash—for neurosis, ii, 156
Waterhouse's system of stable ventilation, iii, 331
Weak fore-legs—appearance, i, 66
Weak points—breeding precautions, iii, 213
Weak ulcers—form and treatment, ii, 427
Weakness due to heart disease, i, 465
Weaning of foals, iii, 225, 226; American trotters, iii, 314
Wear—change of teeth due to, iii, 390, 401, 402
Weather as cause of disease, i, 213, 222, 292
Weaving as a vice, i, 413–415; iii, 140; warranty, iii, 424
Wedge-heel shoe for sprain of back sinews, ii, 354, 355
"Wedgwood"—Suffolk measurements, &c., i, 197
Weed disease—see Lymphangitis.
Weed killers—poisoning by, iii, 48, 49
Weeds causing water contamination, iii, 129
Weight of a horse—conformation and distribution—tables, &c., i, 91–93; locomotion and distribution, iii, 191, 194; lever action and functions of limbs, i, 33, 34, 67; standing position, iii, 191; weight for hunters, i, 138, 143; saddle horses, i, 149; Suffolks, i, 200
Weights for various drugs, &c., iii, 11, 12
Weights in training show horses, iii, 312
"Well let down" thigh conformation, i, 85
"Well ribbed up" conformation, i, 56, 148
Well-water purity and analysis, &c., iii, 122, 124, 126
Welsh pony—origin, appearance, &c., i, 196
Westmoreland pony—origin, appearance, &c., i, 197
Wetting of food to induce appetite, iii, 94
Weymouth bridle—type of, iii, 358, 359
Whalebone probe for lithotomy, i, 363
What to do in cases of poisoning, iii, 44, 45
"What's Wanted" (2332)—pedigree, &c., i, 176
Wheals on skin, ii, 136
Wheat—as food, composition, &c., i, 242, 243; iii, 89, 109, 349. poisoning caused by dressing, iii, 49
Wheat-straw—as food, iii, 89, 97, 99, 112, 354; for bedding, iii, 354
Wheezing due to bronchitis and asthma, ii, 2, 11
Whip—dislocation treatment, ii, 352; eye injury, ii, 111; training uses, iii, 301, 315
Whip-rack—fittings, iii, 332
Whip-worm—in intestines, ii, 171
Whisky—accidents and stimulant uses, ii, 449, 460; for colic, i, 281, exhausted horses, ii, 6, mares after foaling, iii, 227; pneumonia and pleurisy, ii, 9, 16
Whistling—see Roaring and Whistling).
Whistling by grooms during grooming, iii, 135
White arsenic—medicinal uses, ii, 453
White corpuscles of blood—composition, &c., i, 432, 434, 446; changes due to disease, ii, 24
White horses—origin, breeding, &c., i, 200, 207
White line across eye due to injury, ii, 111
White line of abdomen—form, &c., ii, 335
White markings on Suffolks, i, 190
White of the eye—see Sclerotic).
White spots on eye disease signs, iii, 369, 379
White substance of Schwann—nerve structure, i, 379
White substance of spine and brain, i, 381, 382, 383, 385, 387
"White Turk"—history, iii, 544
White worm in intestines, ii, 170, 171
"Whites" in mares, ii, 92—drugs, iii, 5, 8
Whitewash—as an antidote, iii, 51; for stable walls, iii, 338
Width—conformation and determination, i, 98, of chest, i, 66, of croup, i, 58, 59
Wild horses—Arabian history on, iii, 518; fossil remains of Mongolian horse, iii, 513; natural food, i, 241; rarity of, iii, 496
Will power of a horse, i, 388, 390, muscles control, ii, 305
"William the Conqueror" (2343) pedigree, &c., i, 185
Williams, Prof., on various diseases, &c., i, 321, 417, 459, 499; ii, 20, 27, 29, 30, 152, 289
Willow bark—medicinal uses, ii, 452
Wilson pony—breeding, appearance, and prices, i, 150, 161, 170, 171
Wilson's muscle of urethra, ii, 73
Winan's trotters (illusts.), iii, 314
Wind and the ventilation of stables, iii, 72, 73
Wind of horse examination of soundness, iii, 385
Wind-galls—forms and treatment, ii, 355–357; unsoundness and warranty, iii, 381, 421
Wind-sucking—causes and treatment, i, 413–415; ii, 466, iii, 140, 343; unsoundness, iii, 140
Winded animals—treatment in field, &c., ii, 6
Windows—stable structure and ventilation, iii, 70, 71–74, 76, 80, 81, 330, 331
Windpipe or Trachea—
Formation and uses, i, 13, 485—muscles connected, ii, 310, 321
Injections—see Intra-tracheal injections).
Mustard plasters on, iii, 33
Treatment in disease, &c.—laryngitis and tracheotomy, i, 509; roaring and tube insertion, i, 511, 512; tongue inflammation and opening, i, 253; ulceration effects and appearance, ii, 10, 34
Windsor stud—foundation, i, 110
Wings of coffin-bone, ii, 200
Winser's gullies and trap for stable drainage, iii, 85, 330
Winter-green—medicinal uses, ii, 452
Wire—for wound-stitching, ii, 411, 413; injuries due to, ii, 386, 413
Wisps of straw for grooming, iii, 134
Witch-hazel—medicinal uses, ii, 463
Withers—
Conformation and forms, i, 13, 52–55, defects compensation, i, 102; height influences and measurement tables, &c., i, 92, 93–95; iii, 288, 294–297; muscle connections, i, 53; ii, 322
Diseases, &c., affecting—boils and ulcers, ii, 150, 151, 426, fistulous withers, ii, 432–434, ringworm and mange, ii, 164, 167, wring withers, i, 220; iii, 1
Withers—*Cont*
Fractures in region of, ii, 236
Poulticing, iii, 31, 32
Rate of growth after birth, iii, 295–299
Wolves' teeth—formation, &c., i, 332; iii, 389, 399, 494
Womb—see Uterus or Womb
Wood—mangers and infection by, iii, 154, 155, pavements causing fractures, ii, 224, 230, stable stalls and walls, &c., iii, 324, 325
Woollen bandages—uses, &c., iii, 36
Word of mouth—warranty regulations, &c., iii, 405, 407–409, 413, 420
Work food regulation, &c., during, iii, 93, 94, 99, 100, selection of horses for particular work, iii, 339, 340, treatment of pregnant mares, iii, 217, 264, of show horses, iii, 311, training of horses, iii, 302, of thoroughbreds, iii, 304–306, of trotters, iii, 315, 316
Working power—food influence, iii, 99, 100
Worms—
Description and forms of, ii, 159, 162, 169–175, generation, iii, 260, 261
Drugs, ii, 453, 465, 466, 471; iii, 6, ball and powder prescriptions, iii, 16, 17, abuse of arsenic, iii, 48
Liver, stomach, and intestines—worms infesting, i, 313–315; ii, 169–174
Symptoms or causes of anæmia, i, 479; arteries and vein diseases, i, 471, cough, ii, 13; eye, ii, 175; indigestion, i, 273; seedy toe, ii, 370, 374; spinal paralysis, i, 421; tetanus, ii, 45
[See also Fluke-worms, Tape-worms, &c.; for special worm see its title.]
Wounded animals first aid, &c., ii, 437–441
Wounds and their Treatment—
Antiseptics and drugs for, ii, 420, 421, 450, 455, 486, 488, 489; iii, 2, 3, 4, 6, 7, 8
Arrest of bleeding and general treatment, ii, 408–410, 415
Closing and cleansing, ii, 410, 438—disinfection of instruments used, ii, 415; first aid, ii, 437–439, stitches, needles, &c., ii, 410–419
Feet wounds—danger and cleansing, ii, 380, 381
Forms of incised, lacerated, contused, punctured, and poisoned wounds, ii, 402, 403; special treatment for, ii, 410–414
Healing—natural processes, ii, 404–407
Symptoms or causes of disease—blood-poisoning, i, 482, epizootic lymphangitis, ii, 59, 60, 62; fractured ribs, ii, 254, joint diseases, ii, 279, 280, 282, 285, 287, 288; liver inflammation, i, 306, speedy cutting, ii, 401; vaginitis and vagina wounds, ii, 91, 92, 99, tetanus and danger of dressing, ii, 45, 46, 47
[See also titles Broken knees, Cracked heels, Fistula, Fistulous wounds, Quittor, Sinus, Ulcers.]
Wrist of horse and man—comparison, iii, 485, 486, 490
Written warranties—forms, &c., iii, 405, 413, 420
Wrung withers or shoulders—cause and drugs, i, 220; iii, 1
"Wykeham Mabel" and foal illusts., iii, 268

X

Xeroderma—skin disease, ii, 153
Xiphoid cartilage—of breast-bone, ii, 199
Xiphoid region—conformation, i, 91

Y

Yard of stables -plans and fittings, &c., iii, 320–324, 334, 335.

Yearlings castration, iii, 172; forcing for sale, i, 197, 112, 113; rate of growth, tables, &c., iii, 294–296, 297; teeth of, iii, 393, 396; training—hunters, iii, 307, 308, thoroughbreds, iii, 305, trotters, iii, 314.

Yellow discoloration due to liver, i, 303, 304, 307.

Yellow fluid due to horse-sickness, ii, 56.

Yellow masses in glands due to tuberculosis, ii, 51.

Yellow oxide of mercury—uses, ii, 488.

Yellow scabs due to ringworm, ii, 165.

Yellow worm infesting intestines, ii, 170, 171.

Yellows, The—causes, treatment, &c., i, 304.

Yew poisoning and its treatment, iii, 55, 104, 105; gastritis due to, i, 274.

Yolk of ovum—formation, &c., ii, 79, 80.

Yorkshire boots -use in "cutting", iii, 455.

Yorkshire coach horses—appearance and crosses, &c., i, 133–135; as hunters and harness horses, i, 136, 152; comparison with Oldenburghs, i, 208; illustration of, ii, 161.

Z

Zad-el-Rakeb breed of horses—origin, iii, 518.

Zadig and the story of the lost dog and horse, iii, 473–475.

Zebras—cross in horse-breeding, iii, 241; horny growths, iii, 478; origin, iii, 525; special features as distinct from horses, iii, 496.

Zinc—medicinal uses, ii, 454, 456; iii, 4, 7, 8—doses, iii, 10, 11, sulpho-carbolates as antiseptics, ii, 484, poisoning by, iii, 46.

Zinc gauze for wound dressing, ii, 411, 412

Zona pellucida of ovum, ii, 79.

Zonule of Tinn in eye, ii, 108.

Zygomatic arch—formation, ii, 187; pulse near artery, iii, 140.

Zygomatic process of temporal bone, ii, 185.

Zygomatico-auricularis muscle—form, &c., ii, 311.

Zygomaticus muscle—form, &c., ii, 308.

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